AI Resistance and Price Discrimination

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Abstract

The advancements in intelligent technologies are changing the way that consumers search and shop for products. An emerging trend is the use of intelligent home-shopping devices such as Amazon's Alexa which allow consumers to search and order products using voice commands. We study the impact of such artificial intelligence (AI) enabled devices on a brand's distribution channel strategy and its price discrimination across these channels. After making a theoretical breakdown of the functionalities of the AI-enabled shopping devices into (1) adding convenience in ordering procedure ("OC") or (2) providing support in purchase decision making ("DS"), we document via a set of experiments that consumers who have strong (weak) shopping preferences are less-inclined to shop through AI-enabled devices with the functionality of DS (OC) compared to their existing shopping heuristics. The hesitation of the group to adopt AI-enabled shopping devices makes it efficient for a brand operating in a competitive environment to price discriminate across distribution channels. In the second part of the paper, we build an analytical model and derive the equilibrium distribution and pricing strategies for competing brands conditional on the heterogeneity of consumers with respect to their willingness to adopt AI-enabled devices. We also analyze the welfare impact of the introduction of AI technology as a new possible distribution channel.

keywords: Artificial intelligence, AI-resistance, channel design, price discrimination

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1 Introduction

Consumers do not always embrace technology at the same speed as it is offered. While practically all marketing curricula teach the product adoption curve which suggests that consumers are heterogeneous with respect to adopting new products (Rogers, 1962), there is little research on why some consumers hesitate to adopt new technologies and how firms should respond to this heterogeneity. The differences across consumers with respect to adoption is particularly important given the growing use of advance technologies such as artificial intelligence (AI, from here on) in consumers' everyday lives. Particularly relevant to marketing are the devices which assist in consumer search and shopping, for instance, Amazon's Alexa, Google's Assistant, or Apple's Siri. As the number of tools that are aimed at helping consumers to shop with the assistance of AI increases, it is timely and relevant to investigate how consumers' desire – or resistance – to adopt AI impacts firm strategies of selling through traditional and AI-assisted channels.

In this paper, we study the implications of consumer heterogeneity in adoption of AI-assisted shopping technologies. We first test if consumers differ in their desire to use AI as a purchase aid to either offer them the convenience of ordering, or to assist them in their product search. We test in a series of experiments whether consumers wish to adopt AI providing such benefits, then take our findings to a theoretical model. In the remaining part of the paper, we use the theoretical model based on experimental findings to investigate the competitive implications of this heterogeneity across the traditional and AI-assisted sales channels.

We first explore the factors that shape consumers' perception of AI-assisted technologies and their desire to adopt them. A unique aspect of this exploration is that we focus on the relationship between the strength of preference a consumer has built for a brand and the consumer's desire to buy that product via the AI-assisted channel. Specifically, we explore, if a stronger brand preference which may be built due to familiarity with the brand translates into a desire or resistance to use AI in shopping for this brand. We test this relationship in an experimental setting.

Burke (2002) narrates in the context of new technologies the service functions that consumers want from retailers: (1) detailed product information and (2) fast and convenient shopping experience.[1] In line with this study, we narrow the scope of our study by limiting the functionalities of the AI to two: "decision making support," reducing the cost of search among different products and "convenience of ordering," reducing the cost of ordering a product. We test how consumers respond to each benefit,

[1] The paper also cites other considerations for entertainment products – Consumers want a fun and entertaining experience. Privacy is also mentioned as a minor factor that consumers look for.

conditional on their brand preference.

Our experimental results show that the relationship between the strength of preference for a brand in a competitive market and the desire to adopt AI depends on the benefit offered by the AI-device. When AI offers predominantly ordering convenience, those with stronger brand preferences are more likely to use AI-assisted channels relative to others with weak brand preferences. On the contrary, when AI offers decision-making support, the former group is more resistant to adopting AI relative to those with weaker preferences. These results can be explained by intuition. Consumers with strong brand preferences carry little new product search but are likely interested in lowering their ordering burden. Those without strong preferences may search and compare brands and learn about products before they make any purchases. It is exactly this reason that decision-making support, as a functionality, draws the latter group with weak preferences rather than the former group. Our experimental findings confirm these intuitions.

We take these findings to develop a theoretical model with two competing brands differentiated horizontally, each selling a product through a traditional channel alone or through a traditional and an AI-assisted channel. Consumers in the model are heterogeneous with respect to two dimensions. First, they vary with respect to their preferences between the two competing brands. Second, the potential benefits the AI technology can offer to them varies conditional on their brand preferences. Our theoretical model provides a list of findings relevant to pricing and channel distribution strategies of firms and shows that these functions depend on the functionality of the AI-device they have in the market, as well as the welfare implication of introducing AI-enabled shopping devices to the market.

1. **(AI-Resistance and Price Discrimination)** The introduction of a new, technology-enabled channel allows for price-discrimination across new and traditional channels.

2. (**Specialization in Distribution for Decision Support AI-Channel)** When the AI device is designed to provide decision-making support, only one of the competing firms in the market adopts the AI-assisted channel and the other keeps only a traditional channel, in equilibrium. Thus, each firm specializes in one type of distribution. The firm that adopts AI earns a higher profit than the one that keeps a traditional channel.

3. (**Uniformity in Distribution for Ordering Convenience AI-Channel)** When the AI device is designed to provide ordering convenience, competing firms in the market both adopt the AI-assisted channel in equilibrium. They charge a higher price in the traditional channel relative to the AI-assisted channel, and earn a higher profit relative to when they only sell

through a traditional channel.

4. (**Increased Firm Profits due to Heterogeneity of Attitudes towards AI)** Firms obtain higher profits when there is higher heterogeneity in benefits of AI to consumers. This implies that uniformly increasing the benefits from using AI devices to all consumers is not necessarily profit-increasing.

5. (**Discrepancy in a Technology Provider's Incentives and Social Welfare)** If the AI technology is provided by a third party agent, it will deliberately provide an inferior technology compared to when it is offered by a social planner.

Selling via AI-enabled devices is a growing practice and it is not yet clear how consumers respond to these technologies. A survey of the U.S. consumers shows that while 11% of American consumers own an Alexa device at home[2], only 2% of them have ever shopped via such technologies[3]. Our findings suggest that while it is expected that the AI devices will take off, this may not necessarily imply more AI-shopping for retailers. Some retailers may strategically refrain from selling via AI for competitive reasons. Moreover, findings suggest that marketing managers should embrace consumer aversion to AI for better price discrimination and reconstruct their channel and sales strategies based on these consumer preferences.

Our paper contributes to the growing literature in the human-AI interaction (Kleinberg, Lakkaraju, Leskovec, Ludwig, & Mullainathan, 2017) and implications of technology on firm strategy (Srinivasan, Lilien, & Rangaswamy, 2002; Ram & Sheth, 1989; Sriram, Chintagunta, & Agarwal, 2010). Our study contributes to the former by investigating the two dimensions cited by Burke (2002) in the context of AI adoption. We investigate this relationship from a unique perspective by extending it to the strength of brand preference and the desire to use AI. We contribute to the latter literature by investigating the implications of consumer attitudes towards technology for price discrimination.

The rest of the paper is structured as follows. We start by providing a summary of the relevant literature in Section 2. Then we describe the experimental setting and the findings from them in Section 3. Next, in Section 4 we develop a theoretical model and Section 5 discusses extensions. Finally, in Section 6, we conclude.

[2]Source: https://techcrunch.com/2018/01/12/39-million-americans-now-own-a-smart-speaker-report-claims.
[3]Source: https://arstechnica.com/gadgets/2018/08/only-a-small-percentage-of-users-buy-stuff-through-alexa-report-claims.

2 Relevant Literature

2.1 Artificial Intelligence Appreciation vs. Aversion

As new technologies guided by algorithms are budding, researchers have been increasingly more interested in the interaction between individuals and these new, advanced technologies. In the last few years, the literature in marketing, operations, computer science and psychology offer mixed findings about the reactions of consumers to AI technologies and algorithmic judgments or recommendations. Scholars argue that AI can enhance consumer decision-making, as algorithms aggregate data and information across multiple individuals to reduce the error in decision making (e.g., Soll & Larrick, 2009; Surowiecki, 2004). But the findings about how consumers respond to them diverge. A series of studies argue that consumers appreciate and trust algorithms (e.g., Logg, Minson, & Moore, 2019) studying examples of decision making in the context of weight estimation, song rank forecast, and romantic attraction forecast. Another series argue that consumers exhibit algorithm/AI-aversion. For example, people start to distrust or feel less comfortable making decisions based on machine-based recommendations when they see algorithms err (Dietvorst, Simmons, & Massey, 2016, 2015). In healthcare, consumer resistance to using algorithms has been documented (Chen, 2009; Longoni, Bonezzi, & Morewedge, 2019; Dzindolet, Pierce, Beck, & Dawe, 2002). Prior work also shows that people trust algorithms less when they themselves are experts in the decision task. Recruiters, for instance, trust their judgment more than they trust the algorithm recommendations (Highhouse, 2008) and auditors tend to ignore the fraud predictions provided by system forecasts (Boatsman, Moeckel, & Pei, 1997). Trust in algorithmic advice is reduced when people are overconfident or when the decision is subjective (Logg et al., 2019; Castelo, Bos, & Lehmann, 2019).

While there is no universal explanation for why individuals show aversion to using algorithms, seeing new technologies as a threat to humankind (e.g., George, 2014; Ferrari, Paladino, & Jetten, 2016; Conniff, 2011) triggered by in-group bias (Brewer, 1979), skepticism about the results provided by algorithms (e.g., Highhouse, 2008; Yeomans, Shah, Mullainathan, & Kleinberg, 2017), and the cost of learning to use these new technologies (e.g., Mick & Fournier, 1998; Goodman, 1988) are among the explanations. Existing studies show that consumers would rather rely on their friends than algorithms for product recommendations (Sinha, Swearingen, et al., 2001; Önkal, Goodwin, Thomson, Gönül, & Pollock, 2009). This is because people not only care about the content of recommendations, but also want to understand the recommendation process (Yeomans et al., 2017). Mick and Fournier (1998) point out that new technologies do not by default save time for individuals, but may in fact result in some loss or waste of time due to learning about the technology and whether it fits to consumer needs (Goodman, 1988). An example of such products are small appliances that consumers discover to be less useful than they imagined them to be.

The literature, to our knowledge, does not provide insights about consumers' desire to integrate algorithms in their shopping and product search process. We contribute to the literature by providing key findings in this area. Moreover, to our knowledge, there are no papers which document how consumer brand preferences, familiarity, or loyalty influence AI appreciation or resistance. We also offer results on this end.

2.2 Sales Channels and Price Discrimination

Independently from AI adoption, our study also contributes to the literature on sales channels and price discrimination, two areas which are extensively studied in marketing and other fields. In marketing, seminal papers on channel management typically focus on channel coordination (Gerstner & Hess, 1995; S. C. Choi, 1991; Lal, 1990), vertical integration (Jeuland & Shugan, 2008; Lee & Staelin, 1997), channel design and management (Moorthy, 1988; Coughlan & Wernerfelt, 1989). In this context, typical examinations focused on the models and pricing strategies which maximize downstream member, upstream member, or industry profits. Despite the richness of this literature (A Google scholar search of "channels, marketing" yields 1.7m journal articles), there has been little recent examinations in the intersection of technology products and their impact on the channel structure. The essential question we study is the channel strategy when consumers have different preferences for an AI outlet. In a similar vein, as online economy took off, empirical examinations demonstrated that consumer adoption of online stores depended on the geography of the consumer (Forman, Ghose, & Goldfarb, 2009; J. Choi & Bell, 2011). Similar to this comparison, preference for traditional and AI-assisted channels should be compared. Our paper contributes by providing this examination.

Price discrimination as a function of channel preference has also been a cornerstone in economics (Gerstner, Hess, & Holthausen, 1994; Cavallo, 2017) and marketing research, (e.g., Zettelmeyer, 2000; Besanko, Dubé, & Gupta, 2003; Liu & Zhang, 2006). However, there is, to our knowledge, no research which demonstrates consumers' AI aversion can be a tool for price discrimination. We fill this gap in the literature. In our study, the preference for a channel depends on the preference for the brands, and thus firms can use this information to price discriminate across channels (Bergemann, Brooks, & Morris, 2015).

3 Experimental Evidence

3.1 Hypotheses Development: Consumers' Reaction to AI-Enabled Shopping Devices

The literature documents (Dietvorst et al., 2016; Logg et al., 2019) that consumers may vary in their response to smart devices and programs. We anticipate that these differences will carry over to the context of shopping using such devices. Some consumers may see the benefits of these devices while others may see little benefit, or may even purposefully resist the use of them. What we would like to investigate is whether such attitudes depend on a consumer's preferences for the brands that exist in the market.

As Burke (2002) points out, "it is not the technology per se but how it is used to create value for customers that will determine its success." Burke (2002) proposes two relevant dimensions of benefits that people seek when they buy utilitarian goods: (1) detailed product information that assists consumers in product selection and services when buying infrequently purchased durable goods such as appliances, consumer electronics, furniture, and lighting, and (2) a fast and convenient shopping experience when buying frequently purchased, nondurable goods such as groceries, health/beauty care items, and school/office supplies. We focus on these two dimensions as the main benefits offered by AI-enabled shopping devices. We allow these values to influence consumers differently as the latter or former may exist only for a subset of products.

How do AI-enabled devices impact consumers' shopping experience? First, these devices can make the purchase decision easier via product recommendations, lists, or additional product information that helps one's search process when the customer is not sure of which product to buy. We will refer to this function as Decision Support (abbreviated as "DS"). Or, it can make ordering more convenient via advanced human-computer interactions (e.g., voice command, shopping via camera, etc.) or auto-refilling functions. We will refer to this function as Ordering Convenience (abbreviated as "OC").

Prior research shows some evidence that a consumer's product familiarity/knowledge may affect how she benefits from "DS" and "OC" functions. Consumers familiar with a product category can easily retrieve information about brands and construct preferences for them (Coupey, Irwin, & Payne, 1998; Wright, 1975). Therefore, there is likely a positive relationship between one's product knowledge and brand preference. Prior research also shows that when consumers are familiar with products, it is easier for them to recall the brand names and reorder the same product among a set of alternative products (e.g., Park, Mothersbaugh, & Feick, 1994). The ease of retrieving a brand from memory is expected to make it easier for a consumer to use ordering convenience functions, such as a quick order confirmation via a voice command. Therefore we anticipate that consumers with stronger brand preferences are more likely to be familiar with the brands in the market, and have to exert less effort for recall and thus stand to benefit more from the "OC" function, compared to the consumers have weaker brand preferences.

H_1**:** *Consumers with stronger brand preferences benefit more from ordering convenience.*

As argued above, consumers who hold a strong preference towards a brand should also be more familiar with its products (Coupey et al., 1998; Wright, 1975). They are therefore less likely to benefit from new information provided by the device's "DS" function. Consumers with high product knowledge are familiar with the brands, so they tend to search less when considering existing alternatives (Johnson & Russo, 1984; Bettman & Park, 1980). So we anticipate that for these consumers, the value of recommendations and additional information will be lower compared to those who are less familiar with the product category.

H_2**:** *Consumers with weaker brand preferences benefit more from decision support.*

Moreover, there is evidence that people who are knowledgeable in a domain are less likely to trust AI's (Boatsman et al., 1997). More specifically, Yoon, Hostler, Guo, and Guimaraes (2013) show that a higher product knowledge makes consumers less satisfied with the recommendations given by algorithms. Thus AI-devices with a "DS" function is less likely to inform consumers with more product knowledge, and it is even possible that such information is seen negatively as a nuisance.

H_3**:** *Consumers with strong brand preferences may respond negatively to interacting with decision support features of AI devices.*

Similarly, prior literature demonstrates that factors such as lack of control, tendency to make unplanned purchases and the risk of having to return the products may yield negative benefits from an "OC" function to consumers. For example, Farah and Ramadan (2017) indicate that the convenience brought by Amazon Dash Button facilitates shoppers' impulsive buying behavior. As consumers who are not familiar with a product category and hence do not have a strong preference in the category are more likely to regret buying, we formulate H_4.

H_4**:** *Consumers with weak brand preferences may respond negatively to interacting with the ordering convenience features of AI devices.*

In following studies, we provide experimental evidence to test H_1 to H_4 about the correlation between the strength of a consumer's brand preference and the benefit from DS or OC functions.

3.2 Study 1

The objective of Study 1 is to generate some preliminary evidence that there is a relationship between consumers' brand preference and acceptance of an AI shopping device, moderated by the functionality of the device.

3.2.1 Procedure

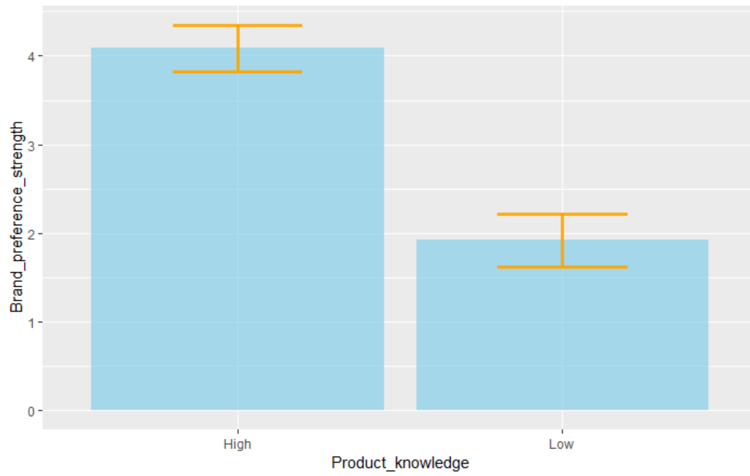
A total of 161 subjects were recruited for a session in a major university's behavioral lab and participated in the study in exchange for monetary rewards. The design was 2 $\times$ 2 (AI device functionality: ordering convenience (OC)/decision support (DS) $\times$ product knowledge: high/low). Each subject was randomly assigned to one of the two conditions describing the function of an AI-enabled device (named "Shopbot"). A randomly selected half of the subjects was told that "Shopbot" was a voice-activated device that offered easy reordering functions ("OC"), and the remaining half was told that "Shopbot" assisted in the search and discovery of products by brand recommendations or listing product criteria for decision making ("DS"). Checks of manipulation were handled at the end of the study by asking whether the subjects thought Shopbot assisted by conveniently ordering or helping choose a brand.

Each subject was then asked to think of a product category she knew/did not know, based on the assignment to two random conditions ("high product knowledge" or "low product knowledge"). We anticipate this manipulation can induce different levels of brand preference strength because prior research shows that a consumer with familiarity with a product category can simply retrieve information about preferred brands but consumers who are not familiar with the product category have to construct preferences on the spot (Coupey et al., 1998; Wright, 1975).

The brand preference strength was directly asked on a 1-5 scale. After this question, subjects were asked to write down their favorite brand (if no favorite brand, an "NA" should be put down). The correlation between the 1-5 scale result and the ability to mention a favorite brand is high ($\rho = 0.84$). In the following analysis we will focus on the 1-5 scaled brand preference strength measurement.

After the subjects indicated the strength of their brand preferences, they were asked a question measuring their acceptance of AI-enabled shopping devices – "When you need to buy this product, how likely is it that you will use Shopbot?" There were 5 potential alternatives, ranging from "highly

Figure 1: Product knowledge and brand preference strength



likely" to "highly unlikely," which were converted to numerical scales $(-2, -1, 0, 1, 2)$ in later analysis. Subjects also answered an open-ended question which asked the reason why they liked/didn't like the AI-enabled device after they provided their acceptance of the AI device.

3.2.2 Results

Among the 161 subjects, 144 subjects who perceived Shopbot's convenience in ordering if they were in OC condition or support in decision making if in DS condition passed the manipulation check. We used the 144 observations in the following data analysis.[4]

First we show that there is a positive relationship between product knowledge and brand preference strength: people who have a high product knowledge have a stronger preference for a brand in that product category ($M_{high} = 4.09$, $M_{low} = 1.92$; $p < 0.01$, Figure 1).

A significant proportion of participants (69 out of 144, 47.9%) revealed a resistance to using AI shopping devices by stating that it is "unlikely" or "highly unlikely" when asked the likelihood of using the device. In order to test the hypothesis that an AI-device featuring ordering convenience (OC) (decision support (DS)) is more likely to be rejected by the consumers with weaker (stronger)

[4]Including all 161 observations does not change the results qualitatively except that one coefficient became insignificant because of the noise introduced by those who did not perceive the corresponding functionality of the AI-enabled device through the description texts. Whether or not passing the manipulation check is not correlated to which condition the subject is in.

brand preferences, we run the following regression:

$$AI\_Acceptance = \beta_0 + \beta_1 \times (Preference\_Strength) + \beta_2 \times (AI\_Function\_DS) + \beta_3 \times (Preference\_Strength) \times (AI\_Function\_DS), \tag{1}$$

where $AI\_Function\_DS$ is a dummy variable indicating whether the subject was told that Shopbot was featuring ordering convenience ($AI\_Function\_DS = 0$) or decision support ($AI\_Function\_DS = 1$). What we care about are the signs of β_1 and $\beta_1 + \beta_3$.

Table 1 shows the estimation results. We can see from the estimates that consumers with stronger brand preferences are more likely to use AI-enabled shopping devices featuring OC (coefficient = 0.157, $p < 0.1$), and are less likely to use AI devices featuring DS (coefficient = $0.157 - 0.549 = -0.392$, $p < 0.01$). These results are consistent with the expectation that if consumers have a clear understanding of the product they need prior to search and shopping, they are more likely to value the OC functionality and a device that offers them this convenience. If, on the other hand, a consumer has weak brand preference, then the consumer is more likely to find an AI-device with DS functionality more useful.

Table 1: Study 1: Strength of Brand Preference and Acceptance of AI-device

	$AI\_Acceptance$
$Preference\_Strength$	0.157^{*}
	(0.094)
$AI\_Function\_DS$	2.306^{***}
	(0.426)
$Preference\_Strength \times AI\_Function\_DS$	-0.549^{***}
	(0.126)
Constant	-1.036^{***}
	(0.323)
R^2	0.208
F Statistic	12.282^{***} (df = 3; 140)

Note: N=144. *p<0.1; **p<0.05; ***p<0.01

3.3 Study 2

Study 1 shows some evidence for the relationship between consumers' brand preference strength and their acceptance of AI-enabled shopping devices featuring different functionalities. There may be several concerns about the design of Study 1. In Study 1, we manipulated the level of product knowledge of a subject by asking her to think of a product that she knew/didn't know about (and then measured the strength of brand preference). Asking subjects to think about a product that they know increases validity of our measurement, since subjects' knowledge is authenticated. One pitfall is that subjects may imagine different product categories, and the relationship between brand preference strength and AI acceptance is measured by averaging across different product categories, rather than for a single category. In Study 2, we design an experiment where we give the participants specific product categories and two brands in this category so that we can test if the findings from Study 1 extend to same product categories. We do not have a prior expectation here as there are two potential issues. First, the categories and the brands we choose may be familiar to the subjects, or not. To increase the likelihood of familiarity, we chose product categories that are most commonly sold on Amazon.com, and picked comparable brands with high market shares in the category. Second, it is possible that some product categories are naturally less suitable for selling or buying via AI-assisted devices, and as researchers, we may not be able to capture this. So we anticipate that some product categories may show results different than what is found in Study 1. Nevertheless, the setting in Study 2 is aligned with the setup of a Hotelling model, which will be used in the analytical model in Section 4.

3.3.1 Procedure

Study 2 was carried out with subjects on Amazon Mechanical Turk. A total of 150 MTurkers participated in the study in exchange for monetary rewards. Similar to Study 1, half of the subjects were provided with a paragraph describing that the AI-enabled device "Shopbot" was featuring OC,[5] and the remaining half were told that "Shopbot" was featuring DS.

Subjects were then asked to reveal their preference over two headphone brands (Sony and Bose) as well as the strength of the preference. Specifically, one was asked first "which headphone brand do you prefer?" with three options (Sony, Bose, or no preference), and if she chose one of the two brands, there would be a follow-up question asking whether her preference was strong (Yes/No). Combining the two questions, one's brand preference is represented at one of the following five levels: "Strongly prefer Sony," "Prefer Sony," "No preference," "Prefer Bose," and "Strongly prefer Bose," which was converted to a numerical scale $(-2, -1, 0, 1, 2)$ in the follow-up analysis. After revealing their preference over brands, they answered the same question as in Study 1 measuring their acceptance of

[5]There was a slight change in phrasing based on the feedback from participants of Study 1 – they had concerns about whether the shipping would cost a lot or if they would incur other hidden fees, so some did not perceive ordering as convenient. Thus, in OC condition of Study 2, the subjects were told that they could still learn the prices if they wanted to, and the shipping cost was marginal.

AI-enabled shopping devices – "When you need to buy a headphone, how likely will you use Shopbot?" There were again 5 alternatives, ranging from "highly likely" to "highly unlikely" (converted to a numerical scale $(-2, -1, 0, 1, 2)$ in later analysis). Similar questions were asked again for a second product category: cereals. We wanted to test our hypotheses for both expensive, less frequently bought products (headphone) and cheap and frequently bought products (cereals).

Since we are generally concerned about the quality of data from the subjects on MTurk, a comprehension/attention check question was embedded in the survey, asking "which of the following is the function of Shopbot?" followed by three options with one correct answer and two decoys. This was a straightforward question for any subject reading the instructions and paying attention. 100 out of the 150 subjects answered the question correctly and we carry out the analysis using the 100 observations in the following analysis. [6]

3.3.2 Results

We first show a model-free evidence supporting our hypotheses in Figures 2 (for headphones) and 3 (for cereals). In each figure, the x-axis is the strength of brand preference, with the indifferent consumers in the middle and consumers with strong preferences on each end, and the y-axis is the average acceptance of the AI device. The circles represent the responses in the OC condition and the triangles represent the responses in the DS condition. We can see roughly a "V-shaped" curve in OC conditions and an "inverse-V-shaped" curve in DS conditions for both products. This is consistent with what we expected before – for AI devices featuring OC (DS) function, those with stronger (weaker) brand preferences are more accepting of the AI device (corresponding to a higher value in the y-axis).

In order to statistically test the relationship, we run the same regression as we did in Study 1:

$$\begin{aligned} AI\_Acceptance = \beta_0 + \beta_1 \times (Preference\_Strength) + \beta_2 \times (AI\_Function\_DS) \\ + \beta_3 \times (Preference\_Strength) \times (AI\_Function\_DS), \end{aligned} \tag{2}$$

where $Preference\_Strength$ is calculated as the absolute value of the brand preference level (converted to the numerical scale in the range [-2, 2]). $AI\_Function\_DS$ is, like in Study 1, a dummy variable indicating whether the subject was told that Shopbot was featuring ordering convenience ($AI\_Function\_DS = 0$) decision support ($AI\_Function\_DS = 1$). We are interested in the sign of β_1 and $\beta_1 + \beta_3$.

[6] Whether or not passing the attention check is not correlated to the experimental condition a subject is in.

Figure 2: Study 2 Results: Headphone

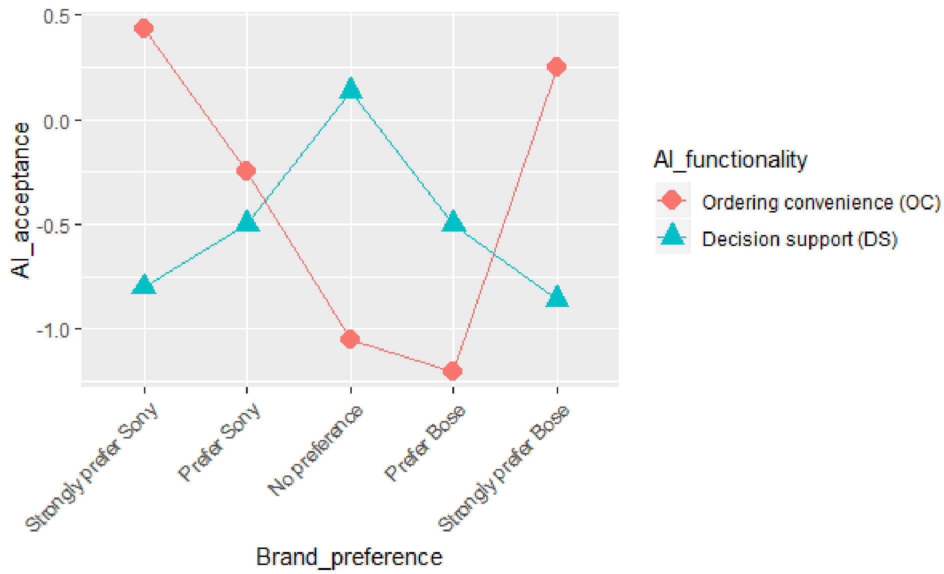


Figure 3: Study 2 Results: Cereals

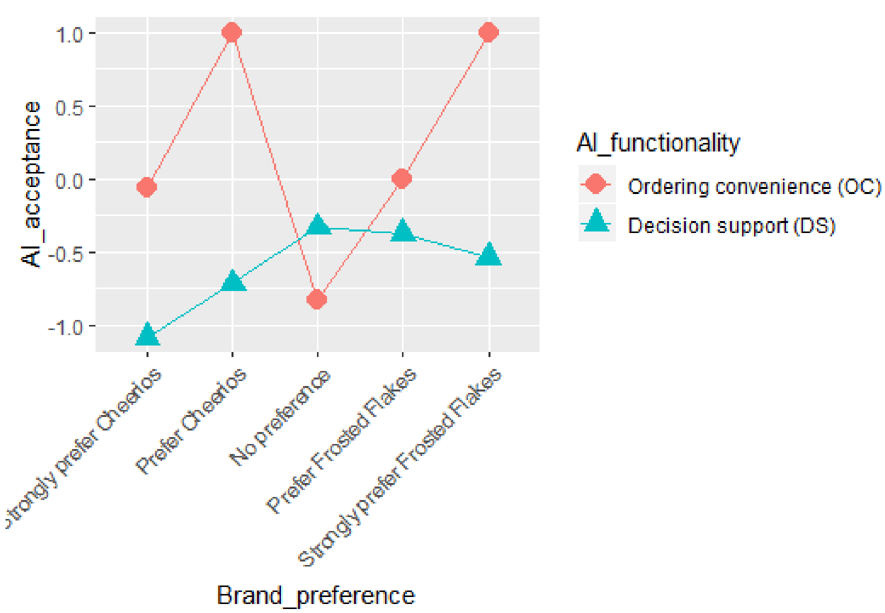


Table 2 shows the estimation results. We can see that for both products, β_1 (relationship between brand strength and acceptance of AI with OC) is positively significant, in line with our expectation. The coefficient of the interaction term is negative and significant. We can calculate the relationship between brand strength and acceptance of AI with DS ($\beta_1 + \beta_3$): for headphone, the coefficient is $0.716 - 1.200 = -0.484$, $p = 0.01$; for cereal, the coefficient is $0.574 - 0.813 = -0.239$, $p = 0.35$ (not significant). We can see that both point estimates are negative, which is consistent with what we expected. The effect of AI with DS for cereals is less precisely estimated, possibly because consumers are less likely to need a decision support system for a cheap, frequently purchased product. Buying a less preferred product is not as costly for such a product.

Table 2: Result of Study 2

	AI_Acceptance	
	(Headphone)	(Cereals)
Preference_Strength	0.716***	0.574***
	(0.187)	(0.213)
AI_Function_DS	1.227***	0.444
	(0.336)	(0.496)
Preference_Strength × *AI_Function_DS*	−1.200***	−0.813**
	(0.263)	(0.332)
Constant	−1.119***	−0.759**
	(0.241)	(0.305)
R^2	0.185	0.109
F Statistic (df = 3; 96)	7.244***	3.902**

Note: $N = 100$. *p<0.1; **p<0.05; ***p<0.01

3.4 Summary and Discussion of the Empirical Results

Study 1 and 2 show the fact that the "benefit" (which can be negative) of shopping via an AI-based channel is correlated to the strength of brand preference. The correlation can be positive or negative, depending on what functionality the AI device is providing consumers with. We also see a non-trivial number of people who resist the new technology-based shopping device – those with stronger brand preference when the device features DS and those who with weaker brand preference when the device features OC. This indicates that shopping with the new device may simply provide negative value to some consumers compared with the traditional shopping channel.

Here we provide a heuristic explanation for the main result. When one is familiar with a product, she is more likely to hold a strong preference over brands. Therefore, a possible explanation for the results we have is, the devices featuring OC work better when one is familiar with the product category and has a preferred brand, because ordering is straightforward (e.g.„ via a voice command). However, devices featuring DS work better for consumers who are less familiar with a product category or brand, and therefore need information. We also have a supplemental experiment in Appendix A.1 to replicate what we have found in Study 1 and 2, and partly show the explanation of the relationship between consumers' brand preference and their acceptance of OC/DS AI-devices. As the literature demonstrates (Dietvorst et al., 2015), individuals are skeptical and sometimes resistant to adopting new technologies which use AI and algorithms. They are likely to refuse to use it unless there is a proven benefit to them. In other words, because people incur a "cost" for using AI (psychological threat/skepticism or learning) and the benefit of using AI differs for different people – one accepts only when "benefit" > "cost", and reject when "benefit" < "cost", we can see a pattern of some people accept while the others reject.

4 Model

In this section, we explore the strategic implications of our findings via the experiments in Section 3. More specifically, we build a game-theoretic model incorporating our experimental findings and derive the optimal pricing and product distribution strategy of firms in a competitive market when technology-enabled devices become available.

Consider a market with a continuum 1 of customers and two competing brands. Let two brands lie at the ends of a $[0, 1]$ Hotelling (1929) line, Brand A (at 0) and Brand B (at 1). We assume that customers are uniformly distributed on $[0, 1]$ and a customer located at x has a distance x to Brand A and $1 - x$ to Brand B, with t as the unit transportation cost, which can be interpreted as the extent to which the two brands differentiate. Throughout the paper, we will assume that consumer distance to a brand indicates the strength of her preference for the brand: The closer to 0 or 1 one is located, the stronger is the preference for Brand A or B, respectively. Let V stand for the value of the product to the customers, which is large. A consumer located at x gains a utility of $V - p_A - tx$ if she purchases Brand A where p_A is the price of Brand A's product. Likewise, her utility from buying a product of Brand B is $V - p_B - t(1 - x)$, where p_B is the price of the product from Brand B. We assume that both brands have a marginal production cost of 0 for simplicity.

In the benchmark case where the AI-based or technology-based channel (we will use the terms interchangeably) is not available, which we hereafter refer to as the "traditional channel," we have the well-known equilibrium where the prices are given by $p_A = p_B = t$ and profits by $\pi_A = \pi_B = \frac{t}{2}$.

When the AI-enabled channel becomes available, a firm can choose to sell its products through this second channel or not. In this case, we assume that a proportion α ($0 \leq \alpha \leq 1$) of consumers has access to such a channel. Here, the device that enables the channel may have OC or DS functionality, as we will describe in detail subsequently. Each consumer who owns the device has the choice of ordering a product through the device or buying the product from the traditional channel.

The timeline of the game is as follows: First, the two brands simultaneously decide whether or not to adopt the AI-enabled device as a new distribution channel. After observing each other's adoption decisions, the brands simultaneously set prices in each channel. Finally consumers make purchases. We use subgame perfection as our solution concept and solve the game via backward induction.

As discussed in the previous section, consumers with different strengths of brand preferences may benefit differently from an AI-device. We incorporate this observation into our model by assuming that a consumer may get some additional positive or negative value if she chooses to buy a product from the new channel, depending on her brand preference. Formally, for a consumer at x on the Hotelling line, the added value obtained from buying a product via the AI channel is $\Delta(x)$. To keep our analysis tractable, we assume that the brand differentiation is large enough ($t > \frac{1}{2}$). [7] In the rest of the paper, we will use the superscripts 0 and 1 to denote the variables respectively for traditional and AI channels.

Let the price of product j in the two channels be p_j^0 (traditional channel) and p_j^1 (AI channel), where $j = A, B$. A consumer located at x has four (2×2) choices if both brands decide to adopt the new channel: buying the product of Brand A or B and buying through the traditional channel or the technology-enabled channel. The payoffs ($V_A^0(x)$, $V_A^1(x)$, $V_B^0(x)$, and $V_B^1(x)$) are given in Table 3, and a consumer at x chooses $\max\{V_A^0(x), V_A^1(x), V_B^0(x), V_B^1(x)\}$. Note that if one brand does not adopt the new channel, then a consumer cannot buy that brand via the new channel.

Table 3: Payoffs of a Consumer from Shopping

	Brand	
Channel	Brand A	Brand B
Traditional channel	$V_A^0(x) \equiv V - tx - p_A^0$	$V_B^0(x) \equiv V - t(1-x) - p_B^0$
Technology-enabled channel	$V_A^1(x) \equiv V - tx - p_A^1 + \Delta(x)$	$V_B^1(x) \equiv V - t(1-x) - p_B^1 + \Delta(x)$

The $\Delta(x)$ in Table 3 will depend on the functionality of the AI device available, and also on a consumer's preference, as we have concluded in Section 3. We now provide more details on how we

[7] If the two brands are not differentiated enough (i.e., if $t << \Delta$), there may be no equilibrium solution because a small decline in prices can result in a dramatic change in the demand across channels then a brand may have an incentive to set aggressive prices and deviate from the calculated equilibrium. When $t > \frac{1}{2}$, t is larger than the highest possible added value the new channel can provide. This is a sufficient condition for the results in this paper.

incorporate those conclusions in our theoretical model.

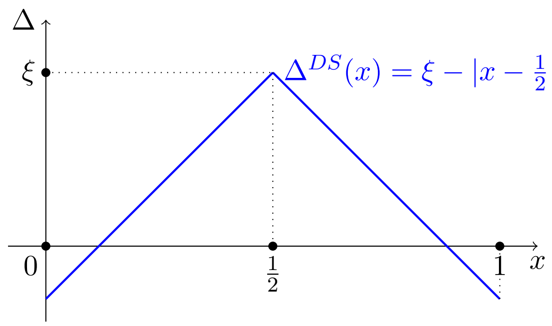
4.1 AI-Devices with DS Functions

We first look at how an AI-device with exclusively DS function may affect competing firms' channel and pricing decisions. Based on the results in Section 3, an AI device featuring DS is more likely to be accepted by those with weaker brand preferences and resisted by those with stronger brand preferences. Consistent with these findings, $\Delta(x)$ in the DS condition is assumed to take an "inverse-V" shape. This shape indicates that the device is valued the most when x is closer to $\frac{1}{2}$ (the mid-point of the Hotelling line where consumers have the weakest brand preference) but valued negatively when x is closer to 0 and 1 (both ends). We let $\Delta^{DS}(\cdot)$ take the following functional form to capture the properties mentioned above:

$$\Delta^{DS}(x) = \xi - \tau|x - \frac{1}{2}|, \tag{3}$$

where ξ is a constant indicating the largest additional benefit a consumer can gain from ordering via the AI channel. We assume that $0 < \xi < \frac{\tau}{2}$ so that $\Delta^{DS}(0) = \Delta^{DS}(1) < 0$ (some consumers have a disutility from using the new channel) and $\Delta^{DS}(\frac{1}{2}) > 0$ (some consumers gain utility from using the new channel). Note that the magnitude of ξ indicates the level of the DS functionality – a larger ξ means that more people enjoy a positive benefit from using such a device (i.e., a better DS functionality). As τ is a scaling factor, we set $\tau = 1$ to simplify our expressions. Figure 4 illustrates the shape of $\Delta^{DS}(\cdot)$ when the AI-enabled device features only DS.

Figure 4: The Additional Value from AI-Channel that Features DS



In the following two subsections, we will discuss the equilibrium in subgames (1) where both brands adopt the new channel and (2) where only one brand adopts the new channel.

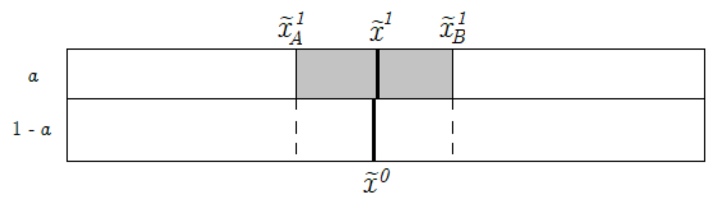
4.1.1 Both Brands Adopt the New Channel

When both brands adopt the new AI-enabled channel, each firm has two pricing decisions (p_j^0, p_j^1) where $j = A, B$.

Lemma 1. *In the equilibrium, there cannot be a consumer who is choosing between buying from a brand's traditional channel and its competing brand's new channel.*

Given a set of prices $(p_A^0, p_A^1, p_B^0, p_B^1)$, we know by the lemma above that the equilibrium configuration is pinned down by the following indifferent consumers: Define $\tilde{x}_A^1$ $(\tilde{x}_B^1)$ as the consumer who is indifferent between purchasing through the traditional channel and the AI-channel among all the consumers who buy from Brand A (B), and $\tilde{x}^0$ $(\tilde{x}^1)$ as the consumer indifferent between the two brands if buying from the traditional (new) channel. Based on the shape of $\Delta(x)$, we know the following must hold: $0 \leq \tilde{x}_A^1 \leq \tilde{x}^0 \leq \tilde{x}_B^1 \leq 1$ and $\tilde{x}_A^1 \leq \tilde{x}^1 \leq \tilde{x}_B^1$. Figure 5 illustrates the equilibrium demand configuration.

Figure 5: The Location of the Indifferent Consumers (DS Case; Both Firms Adopt AI-Channel)



The consumers in the shaded region to the left of $\tilde{x}^1$ buy Brand A through the new channel, while those in the shaded region to the right of $\tilde{x}^1$ buy Brand B through the new channel. The consumers in the unshaded region to the left of $\tilde{x}^0$ buy Brand A through the traditional channel, while those in the shaded region to the right of $\tilde{x}^0$ buy Brand B through the traditional channel. Lemma 2 provides the equilibrium results for when the AI-device offers the DS function and both brands adopt the device to sell their products.

Lemma 2. (Both brands sell via AI-enabled channel with DS) *If both brands sell via an AI-device with DS function, in equilibrium, the prices are* $p_A^0 = p_B^0 = t\left(1 + \frac{\alpha(1-2\xi)}{1-\alpha+4t}\right)$ *and* $p_A^1 = p_B^1 = t\left(1 - \frac{(1-\alpha)(1-2\xi)}{1-\alpha+4t}\right)$*, and the profits are* $\pi_A = \pi_B = \frac{t}{2}\left(1 + \frac{\alpha(1-2\xi)^2(1-\alpha+2t)}{(1-\alpha+4t)^2}\right)$.

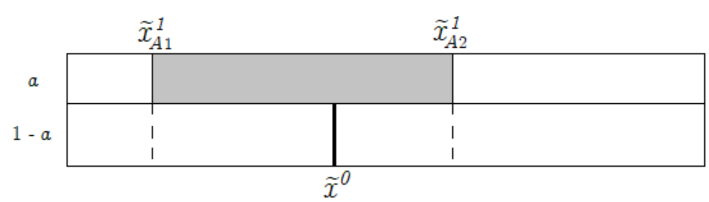
Note that each brand's profit is larger than $\frac{t}{2}$, the profit when they sell only through the traditional channel (benchmark case). This increase in profit stems from price discrimination owing to the fact that consumers with varying brand preferences benefit at different rates from the new channel. It is interesting to see that the prices in the new channel when DS function is featured are *lower* than those in the traditional channel ($p_A^1 < t < p_A^0$, $p_B^1 < t < p_B^0$), implying that people who switch to the new channel pay a lower price although they gain an additional benefit from using that channel! This counter-intuitive finding can be explained as follows. Under DS functionality, the consumers who will be likely to use the new channel are the least sticky consumers with weaker brand preference. The price competition over these consumers is intensified when they are in the new channel. At the same time, the consumers who self-select to remain in the traditional channel are the consumers who do not need to complicate their shopping with a "robot" or AI-device, so the segment which buys from the traditional channel now has a higher valuation of the product, on average. The brands can charge a higher price in the traditional channel. When the profits from the two channels are combined, the equilibrium results give out the following insight: if the "technophobes" are also "picky" about the brands they buy, then they have to pay a higher price in the traditional channel than they used to.

Notice that the prices in the traditional channel are higher when there is a second, AI-enabled channel relative to when there is not. Intuitively, this is because the introduction of the new channel attracts the consumers with weak preferences and changes the distribution of brand preferences among who buy in the traditional channel.

4.1.2 One Brand Adopts the New Channel

In this section we consider the asymmetric subgame where only one of the brands adopts the AI device in distribution. Without loss of generality, we assume that Brand A distributes its goods through both channels, and that Brand B distributes only through a traditional channel. Figure 6 depicts the segmentation of the market for such an asymmetric environment.

Figure 6: The Location of the Indifferent Consumers (DS Case; Only A Adopts AI-channel)



The consumers in the shaded region buy Brand A through the new channel. The consumers in the unshaded region to the left of $\tilde{x}^0$ buy Brand A through the traditional channel, while those in the shaded region to the right of $\tilde{x}^0$ buy Brand B through the traditional channel. Lemma 3 provides the equilibrium prices and profits when only one brand adopts selling via an AI-device with DS functionality.

Lemma 3. (One brand selling via AI-enabled channel with DS) *Suppose that only Brand A adopts the AI-device with the DS function and Brand B sells through the traditional channel alone. There exists a unique solution with equilibrium prices* $p_A^0 = t\Big(1+\frac{\alpha\big(t(9-2\xi)+2(1-\alpha)(3-\xi)\big)}{6(1-\alpha+t)(1-\alpha+2t)}\Big)$, $p_A^1 = p_A^0 + \frac{\xi}{2} - \frac{t}{4(1-\alpha+t)}$, *and* $p_B^0 = \frac{t(6t-2\alpha\xi+3)}{3(1-\alpha+2t)}$, *and equilibrium profits* $\pi_B = \frac{t(3-2\alpha\xi+6t)^2}{18(1+2t)(1-\alpha+2t)}$ *and* $\pi_A = \pi_B + \frac{\alpha(2\xi(1-\alpha+t)+3t)(6\xi(1-\alpha+t)+t)}{24(1-\alpha+t)(1-\alpha+2t)}$.

The lemma suggests that when only one brand adopts the AI-channel, the brand that adopts the AI device sets different prices across channels. The price of Brand A (the brand that adopts the new channel) in the traditional channel, is larger than that of Brand B (the brand that does not adopt the new channel).[8] Brand A's price in the new channel is higher (lower) than that in the traditional channel when α is smaller (larger) than $1-(\frac{1}{2\xi}-1)t$.[9] In other words, when there is a large proportion of consumers who have access to the new channel, the multichannel brand charges a lower price in the new channel than in the traditional channel. In terms of profits, Brand A earns a higher profit than its competitor. Table 4 summarizes the prices and profits of the two brands when only one brand adopts AI-channel, when both brands adopt AI-channel and when neither does; when the new technology enabled channel is featuring the functionality of DS.

Table 4: DS Case: Prices and Profits under Different Adoption Decisions

	Only A adopts AI channel		Both adopt AI channel		No AI channel
p_A^0	$t\Big(1+\frac{\alpha\big(t(9-2\xi)+2(1-\alpha)(3-\xi)\big)}{6(1-\alpha+t)(1-\alpha+2t)}\Big)$	$>$	$t\Big(1+\frac{\alpha(1-2\xi)}{1-\alpha+4t}\Big)$	$>$	t
p_B^0	$t\Big(1+\frac{\alpha(3-2\xi)}{3(1-\alpha+2t)}\Big)$	$>$	$t\Big(1+\frac{\alpha(1-2\xi)}{1-\alpha+4t}\Big)$	$>$	t
p_A^1	$p_A^0+\frac{\xi}{2}-\frac{t}{4(1-\alpha+t)}$	$>$	$t\Big(1-\frac{(1-\alpha)(1-2\xi)}{1-\alpha+4t}\Big)$	$<$	(t)
p_B^1	NA		$t\Big(1-\frac{(1-\alpha)(1-2\xi)}{1-\alpha+4t}\Big)$	$<$	(t)
π_A	$\pi_B+\frac{\alpha(2\xi(1-\alpha+t)+3t)(6\xi(1-\alpha+t)+t)}{24(1-\alpha+t)(1-\alpha+2t)}$	$>$	$\frac{t}{2}\Big(1+\frac{\alpha(1-2\xi)^2(1-\alpha+2t)}{(1-\alpha+4t)^2}\Big)$	$>$	$\frac{t}{2}$
π_B	$\frac{t(3-2\alpha\xi+6t)^2}{18(1+2t)(1-\alpha+2t)}$	$>$	$\frac{t}{2}\Big(1+\frac{\alpha(1-2\xi)^2(1-\alpha+2t)}{(1-\alpha+4t)^2}\Big)$	$>$	$\frac{t}{2}$

Interestingly, when only A adopts the new channel, although Brand A (which adopts the new channel) earns more than Brand B, the profit of Brand B is also higher than that in the case when

[8] $p_A^0 - p_B^0 = \frac{\alpha t(2\xi(1-\alpha+t)+3t)}{6(1-\alpha+t)(1-\alpha+2t)}$ is clearly positive.
[9] $p_A^1 - p_A^0 = \frac{\xi}{2} - \frac{t}{4(1-\alpha+t)}$, and it is great than 0 iff $\alpha < 1-(\frac{1}{2\xi}-1)t$.

both brands adopt the new channel. Thus if there is only one brand adopting the new AI channel in equilibrium, it is good for both brands, including the one that does not adopt the AI channel. Proposition 1 summarizes the equilibrium strategy of brands for AI-channels featuring DS.

Proposition 1. *(***Equilibrium under DS Functionality: Specialization in Distribution)** *For AI-devices offering DS function, in the subgame perfect equilibrium, only one brand adopts the new channel. Both brands earn a higher profit than in the traditional-channel-only case, and the brand that adopts the new channel earns a higher profit than the one that does not.*

The findings in this case are informative and important because the symmetric setting induces an (*ex post*) asymmetric equilibrium. The intuition behind is a specialization story. When only one brand (A) adopts the new channel, it can set a high price in the new channel. For Brand A, selling through a new channel serves as a cushion for price increase. This is because when A increases its price in the traditional channel, marginal consumers will go away but some of them are captured by Aâs another channel, where the price is still high. Therefore, the marginal loss of A increasing price in the traditional channel is lower, i.e., A has more incentive to increase price. In a Hotelling model, prices are strategic complements, so the other brand, B, can also increase its price, which contributes to more profit. Remember that in DS condition, it is the least loyal consumers who switch to the new channel, so the competition for these consumers is intense if both brands adopt the new channel, which drives the price down by a lot. If the competing brand (A) has adopted the new channel, it is better for B not to adopt because of this intense competition.

In order to form a deeper understanding of the equilibrium results in the DS case, we carry out another benchmark analysis where the new channel provides a constant additional value for every consumer, i.e., $\Delta(x) \equiv \Delta$. The following lemma summarizes the results in this benchmark case.

Lemma 4. *Suppose the new channel provides a constant additional value for every consumer, i.e.,* $\Delta(x) \equiv \Delta$.

1. *When both of the brands adopt the new channel, the equilibrium prices are* $p_A^0 = p_B^0 = p_A^1 = p_B^1 = t$*, and the profits are* $\pi_A = \pi_B = \frac{t}{2}$ *That is, there is no price discrimination at all and brands' profits are the same as the traditional-channel-only case.*

2. *When only one brand, say A, adopts the new channel, the equilibrium prices are* $p_A^0 = t - \frac{\alpha\Delta}{6}$, $p_A^1 = t + \frac{1}{6}(3-\alpha)\Delta$*, and* $p_B^0 = t - \frac{\alpha\Delta}{3}$*, and the profits are* $\pi_A = \frac{t}{2} + \frac{1}{72}\left(24\alpha\Delta + \frac{\alpha(9-5\alpha)\Delta^2}{t}\right) > \frac{t}{2}$ *and* $\pi_B = \frac{(3t-\alpha\Delta)^2}{18t} < \frac{t}{2}$.

3. In the subgame perfect equilibrium, both brands adopt the new channel.

If we compare the results for the DS case, where $\Delta(x)$ has an "inverse-V" shape, and the results for the flat $\Delta(x)$ case, we can form the following understandings:

First, when both of the brands adopt the new channel, the price dispersion between the new channel and the traditional channel in the DS case does not come from the fact that there is merely a new channel available to some consumers, because a flat $\Delta(x)$ will shut down the price discrimination. Rather, the price dispersion across channels is due to the heterogeneity in consumers' new channel acceptance; specifically, some consumers gain negative additional utility from using the new channel. In other words, the heterogeneity helps the brands distinguish the consumers and direct their least loyal consumers to the new channel, and thus they can leverage the prices in the two channels to price discriminate and yield higher profits.

Second, when only A adopts the new channel, the flat $\Delta(x)$ case yields a higher profit for A but a lower profit for B, compared to the results when both of them adopting the new channel, which makes only one brand adopting the new channel never be an equilibrium result. This is different from the DS case with an "inverse-V" shaped $\Delta(x)$. The key difference between the two cases is that there is an interaction across channels within Brand A in the DS case, which does not exist in the flat $\Delta(x)$ case. In the DS case, there is more incentive for A to increase p_A^0 coming from the interaction of the two channels within Brand A: The loyal consumers (those who are close to 0) are locked with A's traditional channel because they face a negative additional utility from using the new channel. Therefore increasing the price in the traditional channel can earn a higher margin from them. Note that the flat $\Delta(x)$ case does not provide A with such an incentive; instead, by opening a new channel that provides positive additional utility to everyone, Brand A has more power in retaining its customers so it can price more aggressively in the traditional channel. Thus in the equilibrium, p_A^0 is higher than t in the DS case, but lower than t in the flat $\Delta(x)$ case. One can see the point of the interaction of two channels within Brand A more clearly if we solve for p_A^0 in its associated FOC when doing the maximization exercise: For the DS case ("inverse-V-shaped" $\Delta(x)$), $p_A^0 = \frac{4\alpha t p_A^1 + (1-\alpha)p_B^0 - 2\alpha\xi t + t}{2(1-\alpha+2\alpha t)}$; for the benchmark case (flat $\Delta(x)$), $p_A^0 = \frac{p_B^0 + t}{2}$. In the former case, p_A^0 increases with p_A^1 (i.e., within-brand strategic complements), and such effect is absent in the latter case. Since two brands' prices are (cross-brand) strategic complements, the traditional channel price of B is thus higher in the DS case, but lower in the flat $\Delta(x)$ case, which contributes to the different profit levels of B in these two cases, and thus makes B's incentive of adoption different given its opponent has adopted the AI-channel.

It is counter-intuitive and interesting that the results in the DS case show that firms may not always want to adopt and introduce AI in their distribution even when the technology is readily available. We can speculate based on these findings that a future where all brands are selling through Alexa-type devices with decision support function is unlikely to happen.

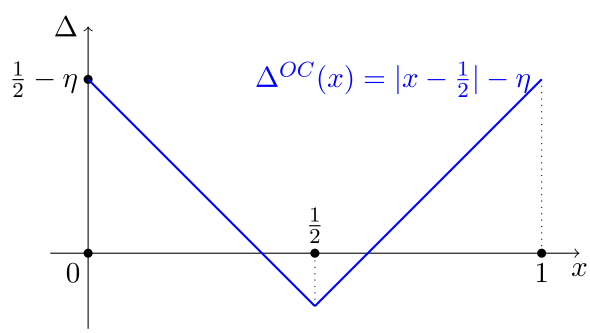
4.2 AI-Devices with OC Function

Our experiments show that, in contrast to the DS function, an AI-device featuring OC is more likely to be accepted by consumers with stronger brand preferences. Thus, in this section we simply reverse the relationship we assumed for the DS function and assume that $\Delta(x)$ has a "V" shape curve taking a negative value when x is close to 0. In particular, we let $\Delta^{OC}(\cdot)$ take the following functional form to capture the properties mentioned above:

$$\Delta^{OC}(x) = \tau|x - \frac{1}{2}| - \eta, \tag{4}$$

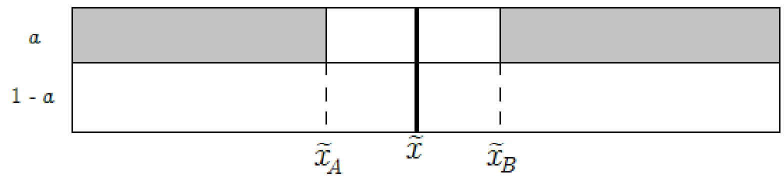
where $0 < \eta < \frac{\tau}{2}$ so that $\Delta^{OC}(0) = \Delta^{OC}(1) > 0$ and $\Delta^{OC}(\frac{1}{2}) < 0$, similar as the DS case. Note that η calibrates OC functionality – a smaller η implies that more people enjoy a positive benefit from using such a device (i.e., a better OC functionality). Without loss of generality, we set the coefficient $\tau = 1$. Figure 7 illustrates the shape of $\Delta^{OC}(\cdot)$.

Figure 7: The Additional Value from AI-Channel that Features OC



Following a similar manner as we did for DS case, we first suppose that both brands adopt the new channel. Figure 8 illustrates the equilibrium demand configuration. All consumers to the left of $\tilde{x}$ chooses to buy Brand A, while all consumers to the right of $\tilde{x}$ chooses to buy Brand B. The consumers in the shaded region buy via the technology-enhanced channel.

Figure 8: The Location of the Indifferent Consumers (OC Case; Both Brands Adopt AI-Channel)



We present in Lemma 5 the equilibrium prices and profits when both brands adopt the AI-device with OC function for selling.

Lemma 5. (Both brands selling via AI-enabled channel with OC) *If both brands add an AI-channel with ordering convenience (OC) function, the equilibrium prices are* $p_A^0 = p_B^0 = t$ *and* $p_A^1 = p_B^1 = t + \frac{1-2\eta}{4}$*, and the equilibrium profits are* $\pi_A = \pi_B = \frac{t}{2} + \frac{\alpha}{4}(\frac{1}{2} - \eta)^2$.

The lemma argues that adopting the AI-channel allows for price-discrimination across consumers conditional on their familiarity with the product. Since the OC functionality yields value consumers who have more certain, strong preferences, thus the brand can sell to these consumers through the new channel and extract more surplus. The prices are higher when sold through the AI-channel relative to those in the traditional channel. The overall profits of the firms are higher as well, as they can price discriminate across consumers and offer some consumers additional value. [10]

The introduction of the new channel does not change the level of competition (as indicated by the prices) in the traditional channel. This is because the new channel only affects the consumers who self-select to shop in the new channel. These consumers are the loyal consumers located closer to the ends of the Hotelling line. In the traditional channels, brands still compete for the indifferent consumer in the middle, and price competition remains unaltered. The more people enjoy the OC technology (i.e., a lower η in our notation), the more a brand can earn because consumers who pay higher prices also receive an additional benefit.

In Proposition 2, we show that brands choose to adopt an AI-channel in the first stage of the game, as it does not have any externalities on the traditional channel and increases the surplus extracted from the loyal consumers. (We provide a summary of the prices and profits of the two brands in Table A3 in Appendix A.3.1.) In equilibrium, both brands adopt the AI-enabled channel to obtain this premium, regardless of the decision that the other brand makes.

[10] It is important to note here that this result is not driven by the assumed functional form of the utility function. It is straightforward to show that the equilibrium prices are always t no matter what functional form one chooses, as long as the form is symmetric for the brands.

Proposition 2. (**Equilibrium under DS Functionality: Uniformity in Distribution**) *For AI-devices offering OC function, in the subgame perfect equilibrium, both brands adopt the AI-channel, the prices in the AI-channel are higher than those in the traditional channel, and both brands earn a higher profit than the traditional-channel-only case.*

The findings in the previous two sections have significant practical implications. A device which offers search and decision support functions (DS) results in a completely different market segmentation and competition structure than that offers OC functionality. While the OC functionality encourages firms to uniformly sell through both channels, and continue to differentiate in the horizontal brand-specific attributes dimension only, the DS functionality encourages brands to differentiate in one additional dimension: their channel strategy. In this case, one brand remains focused on distributing without an AI-device and the other adopts the AI technology.

5 Extensions

5.1 AI-Device with Both DS and OC Functionalities

In the main model, we made a theoretical breakdown of the functionalities of an AI-device into two, OC (ordering convenience) and DS (decision-making support), and analyzed the impact of introducing a device featuring only one of the two on the distribution channel strategy. This was intentional to demonstrate the stark contrast between the strategies under each functionality. However, naturally, such devices may offer both functions together. In this section, we address this possibility.

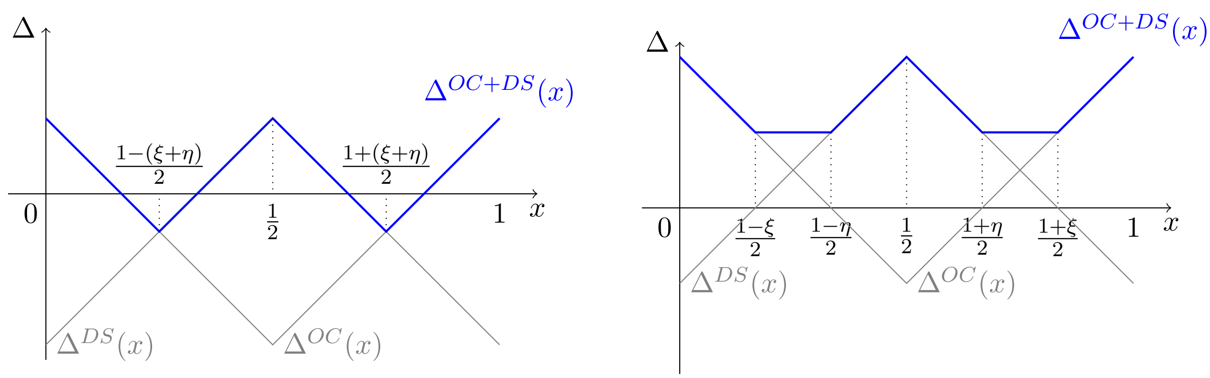
When an AI-device provides both functions, a consumer who buys from this new channel can use (1) DS function only, (2) OC function only, or (3) both functions. It is expected that a consumer will make the decision to use the device such that her benefit is maximized. Formally, a consumer at x can get the additional value

$$\Delta^{DS+OC}(x) := \max\{\Delta^{DS}(x), \Delta^{OC}(x), \Delta^{DS}(x) + \Delta^{OC}(x)\} \tag{5}$$

from using a device offering both DS and OC functions.

Using the formulas for $\Delta^{DS}(x)$ and $\Delta^{OC}(x)$ (described in Figures 4 and 7) one can easily derive the expression for $\Delta^{DS+OC}(x)$ (for brevity, this expression is moved to the Appendix A.3.2). Figure 9 depicts the shape of Δ^{DS+OC}. Part (a) corresponds to the case when everyone uses at most one of the two functions, and part (b) corresponds to the case when some consumers use the device for both functions.

Figure 9: The Additional Value of AI-Enabled Device Featuring Both OC and DS



(a) When $\xi \leq \eta$

(b) When $\xi > \eta$

Following a similar approach to the one in Section 4, we define the equilibrium market structure when the AI-device offers both functions. Note that there are two critical parameters, ξ and η, indicating the advantage of each functionality – a larger ξ indicates a better DS functionality while a smaller η indicates a better OC functionality. When we combine the two functionalities, the relative magnitude of ξ and η is critical to define the equilibrium outcomes. The following proposition summarizes the equilibrium market structure for different combinations of ξ and η.

Proposition 3. (Equilibrium under Both DS and OC Functionalities) *When a device offers both DS and OC functionality, there are five scenarios in the $\xi - \eta$ space to define equilibria outcomes, given in Figures 10 and 11. Figure 10 depicts the equilibrium market structure configuration where the consumers in the shaded regions shop using the AI-channel device. The shape of $\Delta^{DS+OC}(\cdot)$ yields the added utility function in each of the five scenarios. Figure 11 graphically illustrates the parameter space (η, ξ) and the corresponding scenarios, where we fix $\alpha = \frac{1}{2}$ and $t = \frac{2}{3}$ as an example. For brevity, the detailed expressions are put in Appendix A.3.3.*

Proposition 3 provides the key result that different technology profiles (i.e., combination of ξ and η values) induce different market structures. However, even when a device offers a combined functionality, the equilibrium outcomes largely correspond to the ones described in the main section. Scenarios 2 and 3 replicate the outcomes in Section 4 – Scenario 2 for OC and Scenario 3 for DS.

Figure 10: Equilibrium Configuration and Shape of $\Delta^{DS+OC}(\cdot)$ in 5 Scenarios

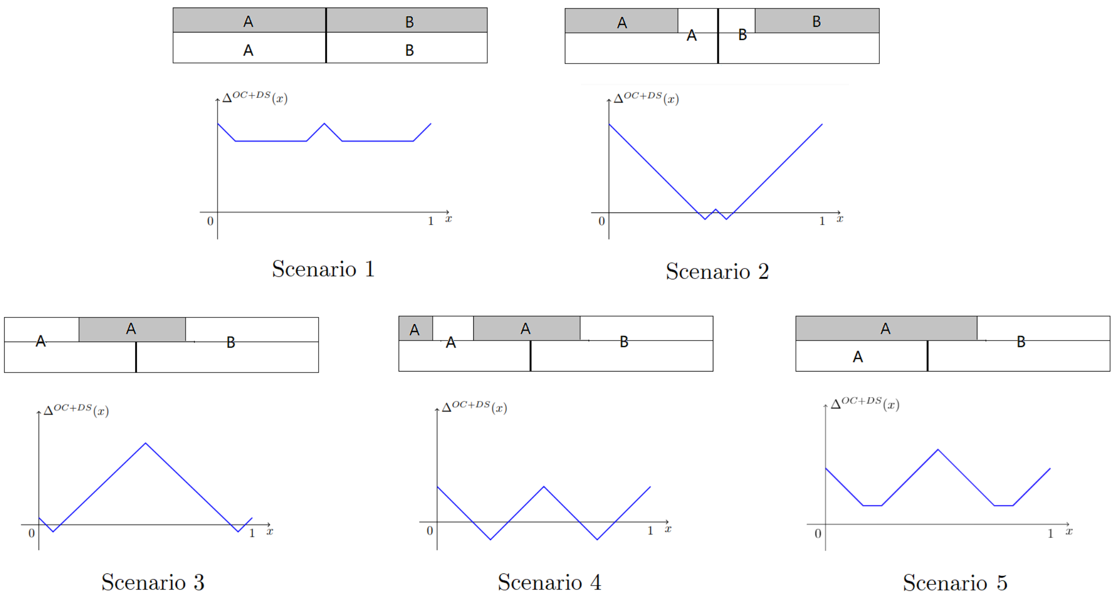
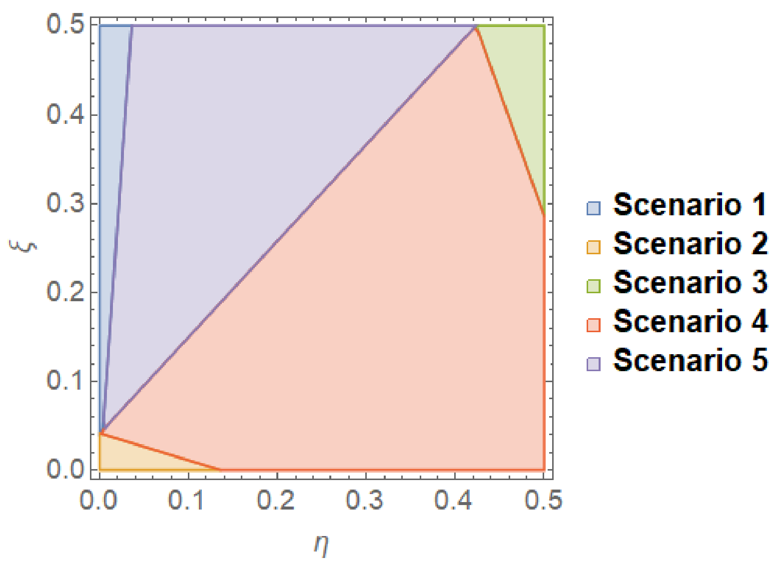


Figure 11: Scenarios and Parameter Space (η, ξ) when $\alpha = 1/2, t = 2/3$



The equilibrium configuration, prices and profits are the same as they were when the device offered only one of the two functionalities. The intuition for this result is simple, as these two scenarios correspond to the regions where the added utility from one function dominates the other.[11]

Scenario 1 corresponds to the case when η is small and ξ is large, implying that both functionalities are beneficial. In this scenario, the AI-channel provides a high overall utility (in combination) to all customers, even when some customers experience a negative added utility from one functionality alone. Since all consumers benefit from the AI-channel at all levels of brand preference, the brands cannot price discriminate via a channel strategy. They sell at identical prices in the AI and the traditional channels. Moreover, this price is identical to the prices in the benchmark case when there is no AI-channel, and yields the lowest profit of the five scenarios described.

Scenarios 4 and 5 correspond to the case when the benefit from the two functionalities are comparable, without one dominating the other. In these cases, the consumers with strong brand preferences can utilize the OC functionality, and those without can utilize the DS functionality of the AI-device. If the consumers with intermediate brand preferences do not see sufficient overall benefit from the device, this corresponds to Scenario 4 where there is a "gap" in the market coverage of the consumers who have access to AI-devices (see Figure 11). Otherwise, the market is covered, corresponding to Scenario 5 (see Figure 11). In these two cases, brands follow a specialization strategy and only one adopts the AI-distribution.

Here, defining the equilibrium profits as a function of ξ and η (see Figure 12), we can compare the profits of each brand. Part (a) of Figure 12 depicts the profit of the brand that adopts AI, while part (b) depicts the profit of the brand that does not adopt AI, as a function of ξ and η. [12]

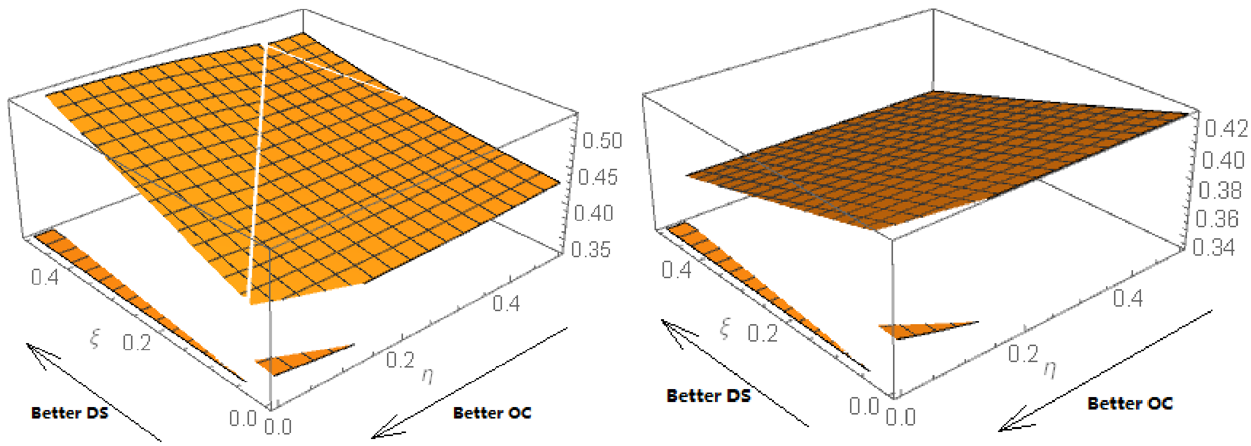
Proposition 4. (Benefits of AI to Consumers and Firm Profits)
(i) An AI-device which elevates all consumers' utility universally is not preferable from the perspectives of firms.
(ii) A device that delivers a negative added utility to some consumers may be preferred over an AI-device that yields positive utility to every consumer.

Propostion 4 part (i) argues that firms do not necessarily benefit from better AI-technologies in

[11]For example, in Scenario 2, both η and ξ are small (see Figure 11). Remember that a smaller η (larger ξ) indicates a better OC (DS) functionality. Thus in Scenario 2, it is the case when OC functionality is very good and DS functionality is very bad so OC is the dominant functionality. Thus the equilibrium looks similar to that in the OC case. Similar logic applies to Scenario 3.

[12]In this section, we always fix $\alpha = 1/2$ and $t = 2/3$ when presenting a figure for ease of illustration. The results of comparative statics hold for general α and t.

Figure 12: The Equilibrium Profits of Brands and Parameter Space (η, ξ) when $\alpha = 1/2, t = 2/3$



(a) Equilibrium Profit of the Brand that Adopts AI

(b) Equilibrium Profit of the Brand that does NOT Adopt AI

a competitive market. From Figure 12, it is clear that no firm would prefer a device that uniformly elevates every consumer's utility. Instead, firms benefit from the heterogeneity in benefits from AI, or, put differently, some consumers' resistance to AI improves firm profits. No firm wants the technology to be as good as possible ($\xi = 1/2$ and $\eta = 0$). We can see from Scenario 1 that both firms just earn the lowest profit in this case. This is because, when the device is beneficial for everyone, firms lose their ability to price discriminate across channels.

The importance of these findings is the following. While many firms stress the importance of investment in AI, developing the perfect AI technology is not mandatory to earning higher profits. A firm's preference for the level of technology (i.e., values of ξ and η) depends on whether or not it is the one adopting the AI channel. When brands specialize in distribution, if the brand that adopts the AI channel could set the benefits from DS-functionality, it would set it to the highest level. This is because this brand targets the consumers with high ξ. On the other hand, the competing brand would set it for the poorest DS functionality to reduce its opponent's competitive power.

Part (ii) suggests that, in fact, it may be better for the firms if some consumers in the market felt strongly against the use of AI, or showed resistance to doing so. The negative added utility from the use of these devices introduces heterogeneity that facilitates better price discrimination across distribution channels. A series of recent studies focus on strategies to reduce consumers' AI aversion (Dietvorst et al., 2016; Longoni et al., 2019). This finding implies that doing so might be detrimental to firm profits. Not everyone should adopt a technology if we consider the profit maximizing consumer behavior.

5.1.1 AI and Welfare

In this section, we investigate the welfare implications of technology from the perspective of firms and consumers.

Proposition 5. (AI and Welfare)
Both consumer surplus and social welfare are the highest under a perfect technology ($\xi \to 1/2, \eta \to 0$). However, if the AI technology is provided by a third party agent, its profit is maximized when DS technology is perfect but the OC technology is imperfect ($\xi \to 1/2, \eta = \hat{\eta}$ where $\hat{\eta} > 0$).

It is easy to see that consumers should prefer the best technology as long as the prices are not overly high. In the Appendix we compare the welfare obtained from various values of ξ and η[13] and find that it is maximized when consumers receive the best device. Here we find that the firms' preferred level of technology is different from consumers' preferred level.

Moreover, the equilibrium social welfare is the sum of both brands' profit and consumer surplus, as a function of η and ξ. Social welfare is also maximized when the technology is perfect, i.e., $\xi \to 1/2, \eta \to 0$, as demonstrated in Figure 13a.

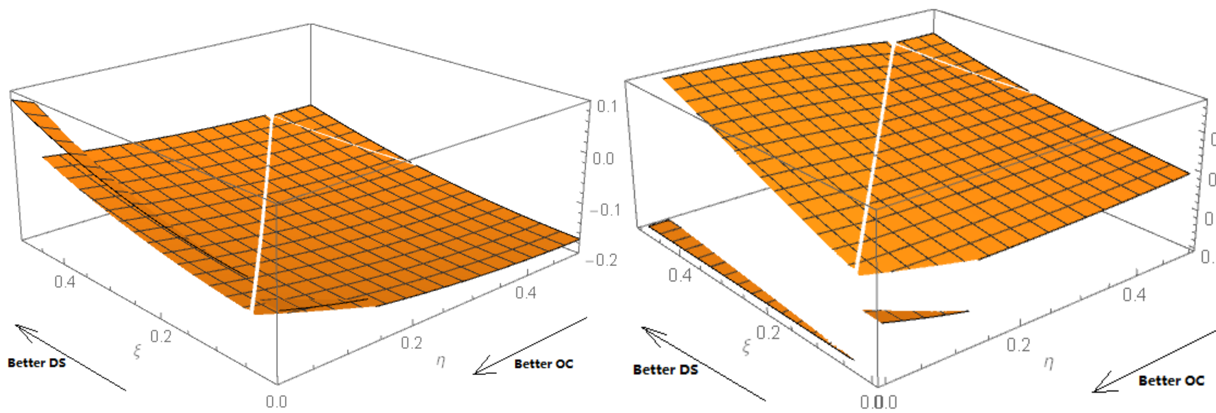
Consider a third party technology provider, which can provide an AI-enabled device to firms. The maximum it can charge for a firm which is using the AI-device is the increase in the firm's equilibrium profit now compared to the case when the firm did not use the device while the other firm's adopting decision is kept unchanged.[14] If in the equilibrium both firms adopt the AI-device, the technology provider can get the sum of the increase in profit of both firms. The profit of the technology provider is again a function of η and ξ, illustrated in Figure 13b. The highest profit of the technology provider is obtained when $\xi \to 1/2$ but η at a positive value instead of approaching 0.

We stress the discrepancy between the social welfare and the third party technology provider's profit. A central planner always prefers a "perfect" AI technology (both DS and OC functionalities yielding the highest utility to every consumer) which generates the highest social welfare. If the technology is provided by a third party, however, it will strategically design the OC functionality to be imperfect to obtain the highest profit. It will still provide the highest DS functionality, in line with the socially optimal, even though caring only about its own profit.

[13] The consumer surplus under each scenario is given in the Appendix A.2.9.

[14] In each of our equilibria, for a firm which is selling the product using the device in the equilibrium, its profit always drops to $t/2$ if it did not adopt it.

Figure 13: Social Welfare/Profit of Technology Provider and Parameter Space (η, ξ) when $\alpha = 1/2, t = 2/3$



(a) Social Welfare

(b) Profit of Technology Provider

5.2 Asymmetric Brands

In the main body of the paper, the two brands were assumed to be symmetric. Now let us extend our setting by allowing one brand intrinsically stronger than the other one. Without loss of generality, suppose Brand A is a stronger brand so everyone chooses Brand A can enjoy a higher value by $\epsilon \geq 0$ from its brand equity. I.e., the possible choices a consumer who has access to the new shopping device have and the associated utilities are:

	Brand A	Brand B
Traditional channel	$V + \epsilon - tx - p_A^0$	$V - t(1-x) - p_B^0$
Technology-enabled channel	$V + \epsilon - tx - p_A^1 + \Delta(x)$	$V - t(1-x) - p_B^1 + \Delta(x)$

Carry out a similar analysis as what we did in Section 4, and we can have the following:

Proposition 6. *If Brand A has a higher brand equity than Brand B by ϵ (A is stronger a brand than B),*

- *In the traditional-channel-only case, the equilibrium prices are $p_A^0 = t + \frac{\epsilon}{3}, p_B^0 = t - \frac{\epsilon}{3}$, and the equilibrium profits are $\pi_A = \frac{(3t+\epsilon)^2}{18t}, \pi_B = \frac{(3t-\epsilon)^2}{18t}$.*
- *When the AI-enabled channel is featuring OC, both brands adopt the new channel in the equilibrium.*
- *When the AI-enabled channel is featuring DS, only one brand adopts the new channel in the equilibrium. In particular, if ξ and ϵ are both large enough, it must be the stronger brand that adopts the new channel; otherwise, either brand can be the one that adopts.*

The first part of Proposition 6 shows an intuitive result in the benchmark case when the two brands are asymmetric – the stronger brand can set a higher price and get a higher profit compared to the other one, thanks to the brand equity.

The second bullet point gives a replication of what we have seen in the previous section. If it is your loyal customers that first switch to the new channel (OC), both brands will adopt that channel and use it as a price-discrimination tool and earn more profit. This result remains in the asymmetric case.

The third bullet point of Proposition 6 gives us some new insights. In the previous analysis, we get somewhat an asymmetric equilibrium even in a symmetric setting – only one of the two brands adopts the AI-enabled channel if it is the least loyal customers that benefit the most from the new channel (DS). A natural question would be: which brand will end up adopting the new channel if one brand is stronger than the other one? This asymmetric setting answers such a question. Denote the case where A (the stronger brand) adopts the new channel and B (the stronger brand) does not adopt as (YN) (similarly we can define (NY),(YY), and (NN)). If both ξ and ϵ are large enough, i.e., if the device can bring value to enough people as well as the difference in strength between two brands is large enough, we know that it must be the stronger brand that adopts the new channel rather than the weaker one, i.e., (YN) is the only possible equilibrium. However, when the premises are not satisfied, we cannot tell which brand adopts the AI-enabled shopping device as a new channel, i.e., both (YN) and (NY) are possible equilibria. Figure 14 illustrates the result when $\alpha = 1/2$ and $t = 2/3$.[15]

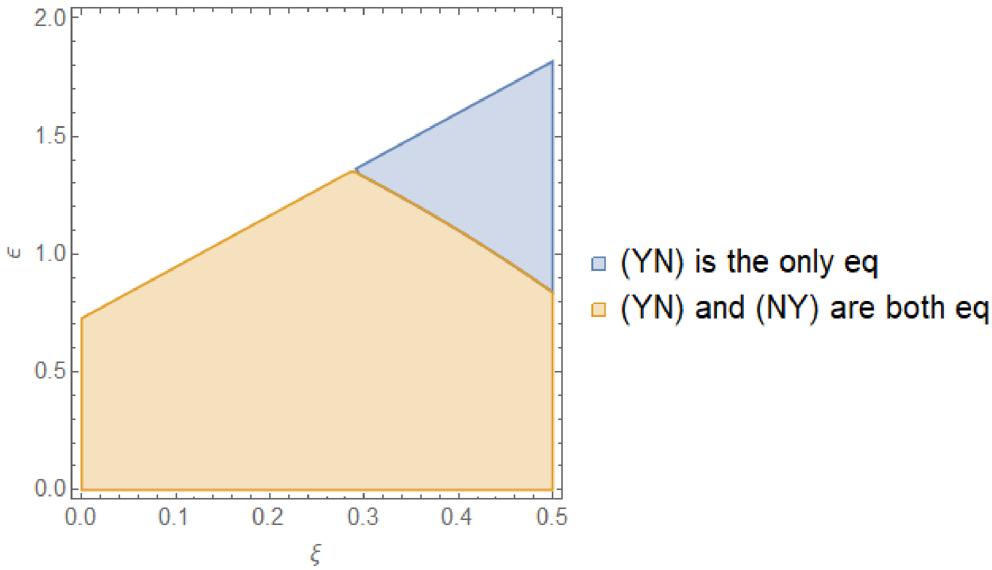
Intuitively, the result comes from the fact that a stronger firm has some advantage in the competition when both firms adopt the new channel, so it is not afraid to "fight with" its competitor face to face.

6 Conclusion

The technology with which consumers search and order products nowadays is significantly different from the technology that they used to have. In the past, consumers have predominantly shopped for goods in person, by doing the physical legwork of search and ordering. Today, an increasing number of shopping devices enabled by artificial intelligence (AI) technology are offered which transform consumer experience. The Amazon Dash Replenishment automatically reorders the product one likes,

[15]The white space is where solution is not well-defined because the two firms diverge too much in terms of strength.

Figure 14: Equilibria and parameter space (ξ, ϵ) when $\alpha = 1/2, t = 2/3$



Alexa allows consumers to ask and order products from Amazon directly using voice and recommends products to consumers when they need, and Google's Assistant does offer similar functionalities for comparison and ordering from various sites.

In this study, we try to understand the impact of the functions provided by the AI technologies in people's shopping experience. The flow of the paper is as follows: We first make a theoretical breakdown of different functionalities of an AI-device, and then experimentally test how a device's functionality and a consumer's brand preference interacts to shape her willingness to use the device. We then theoretically analyze firms' reaction to this interaction in a competitive environment, and show the possibility of price discrimination and resulting distribution strategies. Then we extend our model to incorporate devices offering multiple functions, and carry out welfare analysis for the introduction of such AI-enabled shopping devices.

Our experimental findings show that the acceptance of AI in shopping devices depends on the functionality that the device offers and a consumer's preference strength for the brand. Based on earlier research (Burke, 2002), we investigate two distinct functionalities: ordering convenience (OC) and decision support (DS). It is essential for managers to consider the primary functionality of the device to understand who stands to benefit more from it. When devices offer mainly ordering convenience or when products are ordered by consumers primarily using this function (similar to the dash buttons), those with established brand preferences are more likely to use these devices. When devices serve a search and discover function, it is the consumers with opposite traits, those with less established brand preferences who choose to use these devices. Two experiments we run show results consistent with these findings.

We then take these empirical findings to a theoretical model to provide insights for marketing managers on how to sell and how to price products across these devices and traditional channels. This analysis yields a series of important findings. Most importantly, it demonstrates that the market structure and sales and distribution channels of firms will look very different conditional on the functions of the AI device.

The key findings of this study for managers who are considering selling through AI-devices are as follows.

1. **AI-devices facilitate price discrimination.** AI-devices can facilitate price discrimination since consumers' acceptance of the technology is correlated with their brand preference strength and the device functionality. Consumers self-select into the channel that yields a higher utility for them and firms can enhance profits due to better segmentation.

2. **AI-devices with OC function: differentiation in brand characteristics.** When the primary function of the devices is OC, both brands adopt the AI channel. Brand loyal consumers choose to shop from the new channel and pay higher prices to do so. The prices in the traditional channel remains unaffected, and the channel is more likely to be utilized by the consumers with weaker brand preferences.

3. **AI-devices with DS function: Differentiation in brand characteristics and distribution strategy.** When the primary function of the device is DS, one brand adopts the AI channel and the other does not. The consumers with less established brand preferences are more likely to adopt the new channel, thus managers should anticipate a price competition over the new channel. To mitigate competition, brands choose to differentiate in distribution channels and target consumers with different preferences as a specialization strategy. The traditional channel is utilized by the consumers with stronger brand preferences. The brand charges higher prices to these consumers relative to when it did not adopt the new channel.

4. **Brand-Loyals face higher prices, even when they do not use the AI-channel.** Consumers who are more brand loyal are likely to face higher prices when these devices are adopted by one or both firms with any functionality the device offers. Consumers with weaker preferences may face lower or unchanged prices.

5. **Consumer aversion to AI may not be a bad thing from the perspective of firms.** It may, on the surface, seem like elevating the benefits from shopping with AI-devices for all consumers is likely to benefit firms. In fact, this is true in a monopoly as the firm can charge a higher price to consumers. In a duopoly, however, elevating the utility to everyone can make firms worse off as it eliminates price discrimination ability and therefore enhances price competition. Put differently, the impact of AI technology is less predictable under competition and a higher heterogeneity in consumer benefits from AI can be preferred to maximize firm profits.

6. **AI technology providers may refrain from a perfect technology.** While a perfect technology that benefits every consumer is socially optimal, such a technology is not preferred from the perspective of the provider. A provider prefers to limit the OC functionality while offering the perfect DS functionality.

In sum, the key insight our model offers is that firms can make use of some consumers' resistance to the new, AI-enabled channel to price discriminate and thus gain a higher profit, given the fact that people's channel preference is correlated with the strength of their brand preferences. Different functions induce different distribution strategies. AI-enabled shopping devices featuring OC will induce uniformity in distribution, while those featuring DS will induce specialization in distribution.

Our study offers, for the first time to our knowledge, an analysis of the AI-shopping devices using a combination of experimental and theoretical methods. While we think that the topic and the undertaking are important, our research is not without limits. In our analysis, we focus on the key benefits of technology defined by Burke (2002). There may be additional factors and benefits which are not considered in our research for reasons of keeping the research focused. Future research may want to focus on some of these additional benefits, for instance the entertainment value of shopping or privacy as a consideration. Moreover, in our research we treat the device and channel interchangeably, and there may be additional agents in the market which are intermediaries that enable selling or offer the technology. We intentionally limit the number of players, but researchers who read this study (and make it this far) may find it valuable to think about the additional strategic considerations these intermediaries add to the problem we study.

Appendix

A.1 Supplemental Study

In this study, we let participants make forced-choices between AI-enabled shopping devices with DS and OC functions. Based on our hypotheses, it must be that consumers who have stronger brand preferences will be more likely to prefer OC to DS. The following study tests this corollary.

170 MTurkers participated in the study. They were first randomly assigned to one of the two conditions: high/low *product knowledge*. The manipulation is the same as that in Study 1 ("think of a product category that you know/do not know about"). Then the participants were asked whether they had a preferred brand in this product category (*brand preference strength*), at a scale of 1 (weak preference) to 5 (strong preference). Finally, they were described the two functionalities of AI-devices (DS/OC), and were asked which functionality they liked between DS and OC when they buy the product they just mentioned (*functionality preference*), at a scale of 1 (strongly prefer DS) to 5 (strongly prefer OC).

If we regress *functionality preference* on (1) *brand preference strength*, (2) *product knowledge*, (3) *brand preference strength* and *product knowledge*, we find the results in Table A1.

Table A1: Supplemental Study Results

	Dependent variable:		
	functionality preference (larger means preferring OC)		
	(1)	(2)	(3)
brand preference strength	0.193***		−0.008
	(0.064)		(0.079)
product knowledge		0.988***	1.003***
		(0.191)	(0.246)
Constant	1.850***	1.976***	1.994***
	(0.229)	(0.135)	(0.222)
R^2	0.051	0.137	0.137
F Statistic	9.058***	26.732***	13.292***
	(df = 1; 168)	(df = 1; 168)	(df = 2; 167)

Note: $N = 170$. *p<0.1; **p<0.05; ***p<0.01

First, (1) show that consumers who have stronger brand preferences will be more likely to prefer OC to DS, which goes in line with our hypotheses and replicates what we have found in Study 1 and 2. (2) and (3) partly reveal the possible mechanism behind this phenomenon. We see the positive relationship between product knowledge and OC functionality preference in (2), and the level of product knowledge is what we have manipulated. Thus we conclude a causal relationship between product knowledge and AI functionality acceptance. Also, in (3) we find that if we include both product knowledge and brand preference strength, all the effect of brand preference strength is absorbed by product knowledge. Actually, higher product knowledge will induce stronger brand preference (See Table A2), and the high R^2 indicates the relationship is strong.

Table A2: Product Knowledge and Brand Preference

	Dependent variable:
	brand preference strength
product knowledge	1.953***
	(0.188)
Constant	2.235***
	(0.133)
Observations	170
R^2	0.391
Adjusted R^2	0.388
Residual Std. Error	1.225 (df = 168)
F Statistic	107.942*** (df = 1; 168)

Note: $N = 170$. *p<0.1; **p<0.05; ***p<0.01

Therefore, we may explain why we have seen a relationship between brand preference and channel choice. The reason behind may be that they are both correlated to product familiarity.

A.2 Proofs

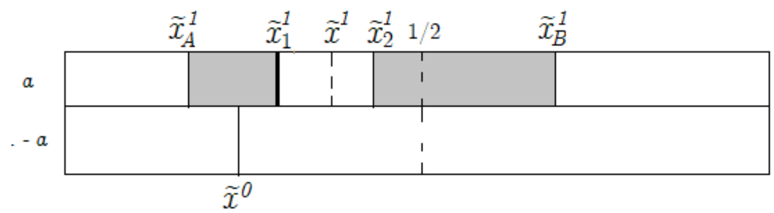
A.2.1 Proof of Lemma 1

Proof. First, it is easy to tell that the consumers that buy from the new channel for a brand (say Brand A), if any, must be a continuous mass. This is because a consumer's utility difference between choosing a brand's new channel and its traditional channel is a single peaked function of x: $V_A^1(x) - V_A^0(x) = \xi - |x - \frac{1}{2}| - p_A^1 + p_A^0$.

Second, we claim that if a consumer prefers buying from A's traditional channel to buying from B's new channel, then any consumers to the left of this consumer should have the same preference order on A's traditional channel and B's new channel. I.e., if $V_A^1(x_1) > V_B^0(x_1)$ and $x_1 > x_2$, then $V_A^1(x_2) > V_B^0(x_2)$. This is because $V_A^1(x) - V_B^0(x) = (V - tx - p_A^1 + \xi - |x - \frac{1}{2}|) - (V - t(1-x) - p_B^0) = -2tx - |x - \frac{1}{2}| - p_A^1 + p_B^0 + \xi = -(2t \pm 1)x \pm \frac{1}{2} - p_A^1 + p_B^0 + \xi$ is decreasing in x (since $t > \frac{1}{2}$, $2t \pm 1 > 0$).

Third, we claim that in the equilibrium there cannot be a brand that obtains zero consumer in the new channel. To show this, one can refer to the proof of Lemma 3, which gives the only candidate equilibrium where B has zero consumers in the new channel. Note that in this case, B has an incentive to simply deviate to a price $p_B^1 = p_B^0$ (if it adopted the new channel in our setting now), because by doing so it cannot lose any margin, but can steal some consumers from A's new channel and do strictly better.

By the three observations above, we can claim that the following is the only possible (logically-consistent) equilibrium configuration if there is a consumer (denoted as $\tilde{x}_1^1$) choosing between buying from a brandâs traditional channel (WLOG, V_A^1) and its competing brandâs new channel (WLOG, V_B^0):



where $\tilde{x}_A^1$, $\tilde{x}^0$, $\tilde{x}_1^1$, $\tilde{x}^1$, $\tilde{x}_2^1$, $\tilde{x}_B^1$ subject to the constraint that $0 \le \tilde{x}_A^1 \le \tilde{x}^0 \le \tilde{x}_1^1 \le \tilde{x}^1 \le \tilde{x}_2^1 \le \frac{1}{2} \le \tilde{x}_B^1$ and are defined by the following equations:

$V - t\tilde{x}_A^1 - p_A^0 = V - t\tilde{x}_A^1 - p_A^1 + \xi - (\frac{1}{2} - \tilde{x}_A^1);$

$V - t\tilde{x}^0 - p_A^0 = V - t(1 - \tilde{x}^0) - p_B^0;$

$V - t\tilde{x}_1^1 - p_A^1 + \xi - (\frac{1}{2} - \tilde{x}_1^1) = V - t(1 - \tilde{x}_1^1) - p_B^0;$

$V - t\tilde{x}^1 - p_A^1 + \Delta(\tilde{x}^1) = V - t(1 - \tilde{x}^1) - p_B^1 + \Delta(\tilde{x}^1);$

$V - t(1 - \tilde{x}_2^1) - p_B^0 = V - t(1 - \tilde{x}_2^1) - p_B^1 + \xi - (\frac{1}{2} - \tilde{x}_2^1);$

$V - t(1 - \tilde{x}_B^1) - p_B^0 = V - t(1 - \tilde{x}_B^1) - p_B^1 + \xi - (\tilde{x}_B^1 - \frac{1}{2}).$

We can thus find the demand for A and B and formulate the following maximization problems:

A's Problem:

$$\max_{p_A^0, p_A^1} p_A^0 \left(\tilde{x}_A^1 + (1-\alpha)(\tilde{x}^0 - \tilde{x}_A^1)\right) + p_A^1 \alpha (\tilde{x}_1^1 - \tilde{x}_A^1).$$

B's Problem:

$$\max_{p_B^0, p_B^1} p_B^0 \alpha \left(\left(1 - \tilde{x}_B^1 + \tilde{x}_2^1 - \tilde{x}_1^1\right) + (1-\alpha)(1 - \tilde{x}^0)\right) + p_B^1 \alpha \left(\tilde{x}_B^1 - \tilde{x}_2^1\right).$$

When one solves this problem, she will find that the constraint that $\tilde{x}_1^1 \le \tilde{x}^1 \le \tilde{x}_2^1$ always binds, which means that $\tilde{x}_1^1 = \tilde{x}^1 = \tilde{x}_2^1$, i.e. all these three points collapse into one in the equilibrium, which is the consumer indifferent between V_A^1 and V_B^1. This simply implies that there is no $\tilde{x}_1^1$ which is the consumer who chooses between buying from A's traditional channel and B's new channel. In other words, the configuration given by Figure 5 is the only possible equilibrium configuration.

□

A.2.2 Proof of Lemma 2

Proof. Suppose first both brands have adopted the new channel featuring DS. By definition, we have

$$\begin{aligned}
V - t\tilde{x}^0 - p_A^0 = V - t(1-\tilde{x}^0) - p_B^0 \quad &\Rightarrow \quad \tilde{x}^0 = \frac{p_B^0 - p_A^0 + t}{2t},\\
V - t\tilde{x}^1 - p_A^1 + \Delta(\tilde{x}^1) = V - t(1-\tilde{x}^1) - p_B^1 + \Delta(\tilde{x}^1) \quad &\Rightarrow \quad \tilde{x}^1 = \frac{p_B^1 - p_A^1 + t}{2t},\\
V - t\tilde{x}_A^1 - p_A^0 = V - t\tilde{x}_A^1 - p_A^1 + \xi - (\frac{1}{2} - \tilde{x}_A^1) \quad &\Rightarrow \quad \tilde{x}_A^1 = \frac{1}{2} - (p_A^0 - p_A^1 + \xi),\\
V - t(1-\tilde{x}_B^1) - p_B^0 = V - t(1-\tilde{x}_B^1) - p_B^1 + \xi - (\tilde{x}_B^1 - \frac{1}{2}) \quad &\Rightarrow \quad \tilde{x}_B^1 = \frac{1}{2} + (p_B^0 - p_B^1 + \xi).
\end{aligned}$$

Note that this is the only possible equilibrium configuration given our assumption that $t > 1/2$ since no one would have the incentive to "invade". We can thus find the demand for A and B and formulate the following maximization problems:

A's Problem:

$$\max_{p_A^0, p_A^1} p_A^0 \left(\tilde{x}_A^1 + (1-\alpha)(\tilde{x}^0 - \tilde{x}_A^1)\right) + p_A^1 \alpha (\tilde{x}^1 - \tilde{x}_A^1).$$

B's Problem:

$$\max_{p_B^0, p_B^1} p_B^0 \left((1-\tilde{x}_B^1) + (1-\alpha)(\tilde{x}_B^1 - \tilde{x}^0)\right) + p_B^1 \alpha \left(\tilde{x}_B^1 - \tilde{x}^1\right).$$

Solving these simultaneously, we get

$$\begin{aligned}
p_{A\text{both}}^0 = p_{B\text{both}}^0 &= t\Big(1 + \frac{\alpha(1-2\xi)}{1-\alpha+4t}\Big),\\
p_{A\text{both}}^1 = p_{B\text{both}}^1 &= t\Big(1 - \frac{(1-\alpha)(1-2\xi)}{1-\alpha+4t}\Big).
\end{aligned}$$

Plugging these back to get $\tilde{x}^0$, $\tilde{x}^1$, $\tilde{x}_A^1$, and $\tilde{x}_B^1$:

$$\begin{aligned}
\tilde{x}_{\text{both}}^0 &= \tilde{x}^1 = \frac{1}{2},\\
\tilde{x}_{A\text{both}}^1 &= \frac{(1-2\xi)(1-\alpha+2t)}{2(1-\alpha+4t)},\\
\tilde{x}_{B\text{both}}^1 &= 1 - \frac{(1-2\xi)(1-\alpha+2t)}{2(1-\alpha+4t)}.
\end{aligned}$$

In order to make sure that the equilibrium exists, we have to check the condition that $0 < \tilde{x}_{A\text{both}}^1 <$

$\tilde{x}^0_{\text{both}}(=\tilde{x}^1_{\text{both}}=\frac{1}{2})<\tilde{x}^1_{B\text{both}}<1$. Note that $\tilde{x}^1_{A\text{both}}<\frac{1}{2}<\tilde{x}^1_{B\text{both}}$ is naturally satisfied under our parameter space. $\tilde{x}^1_{A\text{both}}>0$ and $\tilde{x}^1_{B\text{both}}<1$ are simultaneously satisfied if and only if $\xi<\frac{1}{2}$, which happens to be equivalent to $\Delta(0)=\Delta(1)<0$. In words, when the new channel can even provide some negative additional value to those consumers who have extremely strong preferences, this equilibrium exists. Off-configuration deviations are also checked.

We can thus calculate the total profit of the two brands:

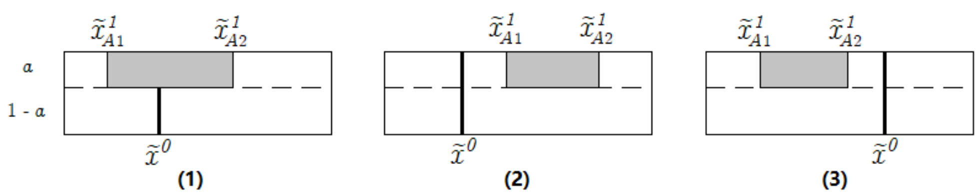
$$\pi_{A\text{both}}=\pi_{B\text{both}}=\frac{t}{2}\Big(1+\frac{\alpha(1-2\xi)^2(1-\alpha+2t)}{(1-\alpha+4t)^2}\Big).$$

In the benchmark case, the profit of each brand was $\frac{1}{2}$. This quantity becomes $\frac{t}{2}\Big(1+\frac{\alpha(1-2\xi)^2(1-\alpha+2t)}{(1-\alpha+4t)^2}\Big)$, so the difference is $\frac{t\alpha(1-2\xi)^2(1-\alpha+2t)}{2(1-\alpha+4t)^2}$ – every factor in this expression is positive (remember that $0<\alpha<1$) and thus the difference is positive. Also, when $0<\xi<\frac{1}{2}$, this difference is decreasing in ξ.

□

A.2.3 Proof of Lemma 3

Proof. Suppose now only one brand (A) opens the new channel. There are three possible interior equilibrium configurations:



The shaded consumers buy Brand A through the new channel. The unshaded consumers to the left of $\tilde{x}^0$ buy Brand A through the traditional channel, while the shaded consumers to the right of $\tilde{x}^0$ buy Brand B through the traditional channel. When $t>1/2$, the first configuration is actually the only one that can support an equilibrium (by a similar claim to Lemma 1).

$\tilde{x}^0$, $\tilde{x}^1_{A1}$ and $\tilde{x}^1_{A2}$ are determined by the following indifference conditions: [16]

$$\begin{aligned} V - t\tilde{x}^0 - p^0_A = V - t(1-\tilde{x}^0) - p^0_B \quad &\Rightarrow \quad \tilde{x}^0 = \frac{p^0_B - p^0_A + t}{2t}, \\ V - t\tilde{x}^1_{A1} - p^0_A = V - t\tilde{x}^1_{A1} - p^1_A + \xi - (\frac{1}{2} - \tilde{x}^1_{A1}) \quad &\Rightarrow \quad \tilde{x}^1_{A1} = \frac{1}{2} - (p^0_A - p^1_A + \xi), \\ V - t(1-\tilde{x}^1_{A2}) - p^0_B = V - t\tilde{x}^1_{A2} - p^1_A + \xi - (\tilde{x}^1_{A2} - \frac{1}{2}) \quad &\Rightarrow \quad \tilde{x}^1_{A2} = \frac{p^0_B - p^1_A + \xi + t + \frac{1}{2}}{2t+1}. \end{aligned}$$

The two brands are solving the following optimization problems to maximize their profits:

A's Problem:

$$\max_{p^0_A, p^1_A} p^0_A \left(\tilde{x}^1_{A1} + (1-\alpha)(\tilde{x}^0 - \tilde{x}^1_{A1})\right) + p^1_A \alpha(\tilde{x}^1_{A2} - \tilde{x}^1_{A1}).$$

B's Problem:

$$\max_{p^0_B} p^0_B \left((1-\tilde{x}^1_{A2}) + (1-\alpha)(\tilde{x}^1_{A2} - \tilde{x}^0)\right).$$

Solving these, we get

$$\begin{aligned} p^0_{A\text{onlyA}} &= t\Big(1 + \frac{\alpha\big(t(9-2\xi) + 2(1-\alpha)(3-\xi)\big)}{6(1-\alpha+t)(1-\alpha+2t)}\Big), \\ p^1_{A\text{onlyA}} &= p^0_{A\text{onlyA}} + \frac{\xi}{2} - \frac{t}{4(1-\alpha+t)}, \\ p^0_{B\text{onlyA}} &= \frac{t(6t - 2\alpha\xi + 3)}{3(1-\alpha+2t)}. \end{aligned}$$

We can plug the equilibrium prices back to get the expressions for $\tilde{x}^0$, $\tilde{x}^1_{A1}$, and $\tilde{x}^1_{A2}$. To make sure that the equilibrium exists and well-defined, the condition that $0 < \tilde{x}^1_{A1} < \tilde{x}^0 < \tilde{x}^1_{A2} < 1$ and $\tilde{x}^1_{A1} < 1/2 < \tilde{x}^1_{A2}$ must hold, which gives us the following equilibrium existence condition:

$$0 < \alpha < \min\{\frac{7\xi + 10\xi t + 3t}{8\xi} - \frac{1}{8}\sqrt{\frac{\xi^2 + 4\xi^2 t^2 + 12\xi t^2 + 9t^2 - 4\xi^2 t + 18\xi t}{\xi^2}}, 1\}$$

When $t > 1/2$, the inequality above is naturally satisfied.

Note that this is only one of the following three (interior) equilibrium configurations. We need also to check neither of the two brands has the incentive to deviate to other configurations (or associated corner solutions). We have checked the possible unilateral deviations to any of the other possible equilibrium configuration and confirmed that $t > 1/2$ ensures that none of which is profitable.

[16] By writing in this way, we implicitly admit that $\tilde{x}^1_{A1} < 1/2$ and $\tilde{x}^1_{A2} > 1/2$. One can always try the other possible assumptions, but they will give rise to solutions contradicting to the assumption. The only possibility that makes the solution exist is $\tilde{x}^1_{A1} < 1/2$ and $\tilde{x}^1_{A2} > 1/2$.

We can then also calculate the profit of the two brands:

$$\pi_{B\text{onlyA}} = \frac{t(3-2\alpha\xi+6t)^2}{18(1+2t)(1-\alpha+2t)},$$
$$\pi_{A\text{onlyA}} = \pi_{B\text{onlyA}} + \frac{\alpha(2\xi(1-\alpha+t)+3t)(6\xi(1-\alpha+t)+t)}{24(1-\alpha+t)(1-\alpha+2t)}.$$

□

A.2.4 Proof of Proposition 1

Proof. Now we need to compare the profits when both adopt the new channel against those when only A adopts.

$$\begin{aligned}\pi_{B\text{onlyA}} - \pi_{B\text{both}} &= \frac{t(3-2\alpha\xi+6t)^2}{18(1+2t)(1-\alpha+2t)} - \frac{t}{2}\left(1+\frac{\alpha(1-2\xi)^2(1-\alpha+2t)}{(1-\alpha+4t)^2}\right)\\ &= \frac{t}{18(2t+1)(1-\alpha+2t)(\alpha-4t-1)^2}\Big[4\alpha\left((\alpha-1)^2\xi((\alpha-9)\xi+6)-6\left(12\xi^2+4\xi-9\right)t^3\right.\\ &\left.+t^2\left(2\alpha\left(44\xi^2-12\xi-9\right)-108\xi^2+12\xi+45\right)-(\alpha-1)t\left((26\alpha-54)\xi^2-12(\alpha-2)\xi+9\right)\right)\Big].\end{aligned}$$

Denote the term inside the brackets as $h(t)$. Then one can easily calculate

$$\begin{aligned}h'(t) &= 4\alpha\left((\alpha-1)\left((54-26\alpha)\xi^2+12(\alpha-2)\xi-9\right)-18(4\xi(3\xi+1)-9)t^2\right.\\ &\qquad \left.+2t(2\alpha(4\xi(11\xi-3)-9)+12\xi(1-9\xi)+45\right),\\ h''(t) &= 4\alpha(2(2\alpha(4\xi(11\xi-3)-9)+12\xi(1-9\xi)+45)-36(4\xi(3\xi+1)-9)t).\end{aligned}$$

Note that $h''(t)$ is a linear function of t, and the coefficient is $-144\alpha(4\xi(3\xi+1)-9) > 0$ when $0<\xi<1/2$, so $h''(t)$ is increasing in t. Therefore, $h''(t) > h''(0) = 8\alpha(2\alpha(4\xi(11\xi-3)-9)+12\xi(1-9\xi)+45)$. Note that $2\alpha(4\xi(11\xi-3)-9)+12\xi(1-9\xi)+45$ is sandwiched between $12\xi(1-9\xi)+45$ and $2(4\xi(11\xi-3)-9)+12\xi(1-9\xi)+45$ and both are positive when $0<\xi<1/2$. Thus we have $h''(t) > h''(0) > 0$, i.e. $h'(t)$ is increasing in t. Therefore $h'(t) > h'(0) = 4\alpha((\alpha-1)\left((54-26\alpha)\xi^2+12(\alpha-2)\xi-9\right))$ which can be shown similarly positive. Following similar procedure, one can finally show $h(t) > 0$, and thus $\pi_{B\text{onlyA}} - \pi_{B\text{both}} > 0$.

Since $\pi_{A\text{onlyA}} > \pi_{B\text{onlyA}}$ and $\pi_{A\text{both}} = \pi_{B\text{both}}$, we know that $\pi_{A\text{onlyA}} - \pi_{A\text{both}} > 0$.

From the calculation above, we have shown that both brands' profits are higher when only A adopts the new channel than those when brands adopt it. By the definition of subgame perfection, we have finished the proof.

□

A.2.5 Proof of Lemma 4

Proof. When both A and B open the new channel, the new channel is just independent from the traditional one, and we can regard the situation as two independent Hotelling lines. Thus the equilibrium prices are just t, no matter for which channel.

When only A opens the new channel, following similar procedure as the prove for Lemma 2, we first find the indifferent consumers $x_0 = \frac{-p_A^0 + p_B^0 + t}{2t}$ and $x_1 = \frac{\Delta - p_A^1 + p_B^0 + t}{2t}$.

A's problem: $\max_{p_A^0, p_A^1} p_A^0((1-\alpha)x_0) + p_A^1\alpha(x_1)$.

B's problem: $\max_{p_B^0} p_B^0(\alpha(1-x_1) + (1-\alpha)(1-x_0))$.

Subject to the constraint that $V - tx - p_A^0 \leq V - tx - p_A^1 + \Delta$ (i.e., $p_A^0 \geq p_A^1 - \Delta$).

Solving this problem, we get $p_A^0 = t - \frac{\alpha\Delta}{6}$, $p_A^1 = t + \frac{1}{6}(3-\alpha)\Delta$ (the constraint is satisfied), and $p_B^0 = t - \frac{\alpha\Delta}{3}$. Plug in the equilibrium prices, and we get the profits $\pi_A = \frac{t}{2} + \frac{1}{72}\left(24\alpha\Delta + \frac{\alpha(9-5\alpha)\Delta^2}{t}\right)$ and $\pi_B = \frac{(3t-\alpha\Delta)^2}{18t}$. Clearly, $\pi_A > \frac{t}{2}$ but $\pi_B < \frac{t}{2}$. Therefore, given that A has adopted the new channel, B has the incentive to also adopt that. Thus the only SPE is when both brands adopt the new channel.

□

A.2.6 Proof of Lemma 5

Proof. First suppose both of the brands have adopted the new, AI enabled channel. By definition, $\tilde{x}_A$, $\tilde{x}_B$, and $\tilde{x}$ are given by

$$V - t\tilde{x}_A - p_A^0 = V - t\tilde{x}_A - p_A^1 - \eta + (\frac{1}{2} - \tilde{x}_A) \quad \Rightarrow \quad \tilde{x}_A = p_A^0 - p_A^1 + \frac{1}{2} - \eta,$$
$$V - t(1-\tilde{x}_B) - p_B^0 = V - t(1-\tilde{x}_B) - p_B^1 - \eta + (\tilde{x}_B - \frac{1}{2}) \quad \Rightarrow \quad \tilde{x}_B = p_B^1 - p_B^0 + \frac{1}{2} + \eta,$$
$$V - t\tilde{x} - p_A^0 = V - t(1-\tilde{x}) - p_B^0 \quad \Rightarrow \quad \tilde{x} = \frac{p_B^0 - p_A^0 + t}{2t}.$$

The two brands are solving the following optimization problems to maximize their profits:

For Brand A,

$$\max_{p_A^0, p_A^1} p_A^0\left((1-\alpha)\tilde{x}_A + (\tilde{x} - \tilde{x}_A)\right) + p_A^1\alpha\tilde{x}_A.$$

For Brand B,

$$\max_{p_B^0, p_B^1} p_B^0\left((1-\alpha)(1-\tilde{x}_B) + (\tilde{x}_B - \tilde{x})\right) + p_B^1\alpha(1-\tilde{x}_B).$$

Solving for the equilibrium, we get $p_{A\text{both}}^0 = p_{B\text{both}}^0 = t$, and $p_{A\text{both}}^1 = p_{B\text{both}}^1 = t + \frac{1-2\eta}{4}$.

Plug the prices back to get the position of indifferent consumers: $\tilde{x}_{A\text{both}} = \frac{1}{4} - \frac{\eta}{2}$, $\tilde{x}_{B\text{both}} = \frac{3}{4} + \frac{\eta}{2}$, and $\tilde{x}_{\text{both}} = \frac{1}{2}$, as well as the profit of the two brands: $\pi_{A\text{both}} = \pi_{B\text{both}} = \frac{t}{2} + \frac{\alpha}{4}(\frac{1}{2} - \eta)^2$.

In order to make sure this equilibrium exists, we have to have the restriction that $0 < \tilde{x}_{A\text{both}} < \tilde{x}_{\text{both}} < \tilde{x}_{B\text{both}} < 1$, which is guaranteed by $0 < \eta < 1/2$.

□

A.2.7 Proof of Proposition 2

Proof. Similar to Lemma 5, if only A adopts the new channel, then the maximization problems become:

For Brand A,

$$\max_{p_A^0, p_A^1} p_A^0 \left((1-\alpha)\tilde{x}_A + (\tilde{x} - \tilde{x}_A)\right) + p_A^1 \alpha \tilde{x}_A,$$

and for Brand B,

$$\max_{p_B^0, p_B^1} p_B^0 \left((1-\alpha)\left(1-\tilde{x}_B\right) + \left(\tilde{x}_B - \tilde{x}\right)\right).$$

Solving for the equilibrium, we get $p^0_{A\text{onlyA}} = p^0_{B\text{onlyA}} = t$, and $p^1_{A\text{onlyA}} = t + \frac{1-2\eta}{4}$.

Notice that the prices are the same as when both adopt the new channel except that B cannot price discriminate its consumers. It is clear that adopting the new channel is only a switch of consumers within a brand, so adopting it and charging a higher price on the new channel will simply increase a brand's profit. Therefore, both brands will adopt the new channel in the subgame perfect equilibrium.

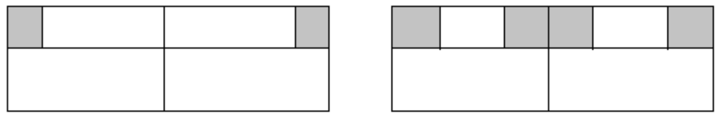
□

A.2.8 Proof of Proposition 3 and 4

Proof. First, suppose both of the brands have adopted the new AI-channel.

We first claim that if in the equilibrium every consumer who has access to the AI shopping device choose to use it, then the only possible equilibrium is when both brands charge t in both channels, which means it just reduces to the case when there is no new channel at all. This is because given that every customer uses the new channel as long as she has the access, the two channels become just two independent Hotelling lines. It is well-known that on an independent Hotelling line, the equilibrium prices are t and the equilibrium profits are $t/2$.

Then let's consider the cases when not everyone having access to the AI device uses it. Since the additional value provided by the AI-channel is in a "W" shape, each brand can choose to set a higher price in the AI-channel to get a premium from its loyal customers ("exploitation") or to set a lower price in the AI-channel to compete for the middle customers ("exploration"). Thus, there are two possible equilibrium configurations when not everyone who has access to the AI device uses it (shaded consumers buy from the AI-channel):



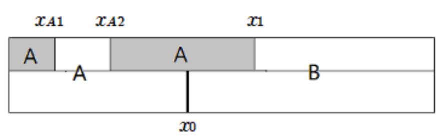
(1) (2)

One may think that there can be another case when only middle (no loyal) consumers buy from the new AI-channel. However this case is impossible because this is the same configuration as Lemma 2 and we know that in that case $p_A^1 < p_A^0$, so the loyal consumers will also switch to the AI-channel since they also gain a positive additional benefit from the new channel, which creates a contradiction. Also, asymmetric cases when one brand "exploits" in the AI-channel while the other one "explores" are not possible equilibria – one can check that the "exploiter" who charge a higher price in the AI-channel will always have the incentive to charge a lower price so that they deviate from the configuration.

Similar to what we have done in the proof of previous propositions, we can find out the indifferent customers and then solve for the equilibrium:

When both brands "exploit" (case (1)), the equilibrium prices are $p_A^0 = p_B^0 = t$ and $p_A^1 = p_B^1 = t + \frac{1-2\eta}{2}$, and the equilibrium profits are $\pi_A = \pi_B = \frac{t}{2} + \frac{\alpha}{4}(\frac{1}{2} - \eta)^2$; when both brands "explore" (case (2)), the equilibrium prices are $p_A^0 = p_B^0 = \frac{t(\alpha(2\eta-2\xi-1)+8t+1)}{-\alpha+8t+1}$ and $p_A^1 = p_B^1 = \frac{t((\alpha-1)(2\eta-2\xi-1)+8t)}{-\alpha+8t+1}$, and the equilibrium profits are $\pi_A = \pi_B = \frac{t\left(-(\alpha-1)\left(\alpha\left(4(\eta-\xi)^2-1\right)+1\right)+64t^2+16t\left(\alpha\left((\eta-\xi)^2-1\right)+1\right)\right)}{2(\alpha-8t-1)^2}$.

Now, suppose only one brand (WLOG, say A) has adopted the new channel. Consider the following configuration:



Again, defining indifferent consumers x_{A1}, x_{A2}, x_0, x_1 as shown in the figure above and solving for the equilibrium as we did before, we get equilibrium prices $p_A^0 = \frac{t\left(-3(\alpha-1)(\alpha(2\eta-1)+6)+48t^2+4t(\alpha(3\eta+\xi-9)+15)\right)}{6(-3\alpha+4t+3)(-\alpha+2t+1)}$, $p_A^1 = p_A^0 + \frac{\alpha(2\eta-4\xi-1)-2\eta(2t+1)+4\xi(t+1)+1}{4(-3\alpha+4t+3)}$, $p_B^0 = \frac{t(6t-2\alpha\xi+3)}{3(1-\alpha+2t)}$ and profits $\pi_B = \frac{t(3-2\alpha\xi+6t)^2}{18(1+2t)(1-\alpha+2t)}$, $\pi_A = \pi_B + \frac{\alpha\left(-8\xi\left(3(\alpha-1)^2(2\eta-1)+4(3\eta-8)t^2-9(\alpha-1)(2\eta-3)t\right)+3(-2\alpha\eta+\alpha+\eta(4t+2)-1)^2+48\xi^2(-\alpha+t+1)^2\right)}{48(-3\alpha+4t+3)(-\alpha+2t+1)}$.

One can check the profit of B is higher than any possible profit it could earn if both A and B adopt the AI-channel (similar to the proof of Proposition 1). Thus, as long as the equilibrium above holds, in the subgame perfect equilibrium, it must be the case that only one of the brands adopts the new channel.

However, there are several conditions that x_{A1}, x_{A2}, x_0, x_1 need to satisfy to make the equilibrium hold: (1) $x_{A1} > 0$, (2) $x_{A2} < \frac{1}{2} < x_1$, and (3) $x_{A1} < \frac{1-\xi-\eta}{2} < x_{A2}$ when $\xi < \eta$; $x_{A1} < \frac{1-2\xi}{2} < \frac{1-2\eta}{2} <$

x_{A2} when $\xi > \eta$.

When all these 3 conditions are satisfied, it is the SPE – only A adopting, prices and profits listed above (Scenario 4).

When (1) is violated, x_{A1} should always equal to 0, i.e. not serving loyal consumers. The equilibrium looks identical to the DS-only case (Scenario 3).

When (2) is violated, no consumer is served in the middle, which becomes identical to the OC-only case. Thus only A adopting is not a SPE. Both brands will adopt the AI-channel (Scenario 2).

When (3) is violated, everyone to the left of x_1 buys from the new channel as long as she has the access.

There are two subcases under the case when (3) is violated:

(a) If $x_1 < \frac{1+2\eta}{2}$, then $x_1 = \frac{2\xi - 2p_A^1 + 2p_B^0 + 2t + 1}{2(2t+1)}$. A is solving the following maximization problem: $\max_{p_A^1, p_A^0} p_A^1 \alpha x_1 + p_A^0 (1-\alpha) x_0$ subject to the constraint that $p_A^1 \leq p_A^0 + \xi - \eta$ in order to make sure everyone to the left of x_0 uses AI-channel. Solving this, we have $p_A^0 = \frac{t(2\alpha(3\eta - 2\xi) + 3(1+2t))}{3(1-\alpha+2t)}$, $p_A^1 = p_A^0 + \xi - \eta$, $p_B^0 = \frac{t(6t - 2\alpha\xi + 3)}{3(1-\alpha+2t)}$. One can check this is still subgame perfect (Scenario 5).

(b) If $x_1 \geq \frac{1+2\eta}{2}$, then $x_1 = \frac{-\eta + \xi - p_A^1 + p_B^0 + t}{2t}$. Following a similar procedure, we have $p_A^0 = \frac{1}{6}\alpha(\eta - \xi) + t, p_A^1 = \frac{1}{6}(\alpha - 3)(\eta - \xi) + t, p_B^0 = \frac{1}{3}\alpha(\eta - \xi) + t$, and $\pi_B = \frac{(3t - \alpha(\xi - \eta))^2}{18t} < t/2$, which is not subgame perfect, so both adopting and let the new channel cover everyone who has the access with price t is the only SPE (Scenario 1).

Proposition 4 is immediate when we have the expressions for firms' profit. We sketch the remaining proof: It is easy to first show the monotonicity of the profit function in ξ or η in each single scenario. Then we can just compare the highest profit a firm can earn within each single scenario to get the global maximum; or compare the highest in one scenario to the lowest in the other scenario to draw any conclusions in terms of cross-scenario comparison.

□

A.2.9 Proof of Proposition 5

Proof. The third party technology provider's profit is easy to calculate because we have already calculated all the firms' profits in different scenarios in Proposition 3. Calculation of the consumer surplus is the key to proving Proposition 5. Once we have the expression of consumer welfare, we can combine the expression of firms' profits in Proposition 3 to get the expression for social welfare. The comparative statics is immediate given that there is dominance across scenarios and monotonicity within scenarios. Below is the calculation details of the consumer surplus:

Scenario 1: $p_A^0 = p_B^0 = p_A^1 = p_B^1 = t$ and $x_0 = x_1 = 1/2$.

$CS_1 = 2\int_0^{\frac{1}{2}} (t(-x) - t + V)\, dx + 2\alpha(\int_{\frac{1}{2}-\eta}^{\frac{1}{2}} (\xi - (\frac{1}{2} - x))\, dx + \int_0^{\frac{1}{2}-\xi} (-\eta - x + \frac{1}{2})\, dx + \int_{\frac{1}{2}-\xi}^{\frac{1}{2}-\eta} (\xi - \eta)\, dx)$

$= \alpha((\eta-1)\eta+\xi^2+\frac{1}{4}) - \frac{5t}{4} + V.$

Scenario 2: $p_A^0 = p_B^0 = t, p_A^1 = p_B^1 = \frac{1}{4}(1-2\eta)+t$ and $x_0 = x_1 = \frac{1}{2}, x_A = -\eta + p_A^0 - p_A^1 + \frac{1}{2}$.

$CS_2 = 2[(1-\alpha)\int_0^{x_0}(-p_A^0 - tx + V)\,dx + \alpha\int_{x_A}^{\frac{1}{2}}(-p_A^0 - tx + V)\,dx + \alpha\int_0^{x_A}(-p_A^1 - tx + V + (-\eta - x + \frac{1}{2}))\,dx]$

$= \frac{1}{16}(\alpha(1-2\eta)^2 - 20t) + V.$

Scenario 3: $p_A^0 = \frac{t(2(\alpha-1)(\alpha\xi-3)+12t^2-2\alpha\xi t-9(\alpha-2)t)}{6(-\alpha+t+1)(-\alpha+2t+1)}$,

$p_A^1 = \frac{6(\alpha-1)^2\xi+24t^3+2t^2(3(5-3\alpha)-2(\alpha-3)\xi)+(\alpha-1)t(2(2\alpha-9)\xi-9)}{12(-\alpha+t+1)(-\alpha+2t+1)}$, $p_B^0 = \frac{t(-2\alpha\xi+6t+3)}{3(-\alpha+2t+1)}$ and $x_0 = \frac{-p_A^0+p_B^0+t}{2t}$, $x_1 = \frac{\xi-p_A^1+p_B^0+t+\frac{1}{2}}{2t+1}$, $x_A = -\xi - p_A^0 + p_A^1 + \frac{1}{2}$.

$CS_3 = (1-\alpha)(\int_{x_A}^{x_0}(-p_A^0 - tx + V)\,dx + \int_{x_0}^{x_1}(-p_0^B - t(1-x) + V)\,dx) + \int_0^{x_A}(-p_A^0 - tx + V)\,dx + \alpha(\int_{\frac{1}{2}}^{x_1}(-p_1^A - tx + V + (\xi - (x - \frac{1}{2})))\,dx + \int_{x_A}^{\frac{1}{2}}(-p_A^1 - tx + V + (\xi - (\frac{1}{2} - x)))\,dx) + \int_{x_1}^{1}(-p_0^B - t(1-x) + V)\,dx$

$= \frac{-9t(2t+1)(4(\alpha-5)(\alpha-1)+40t^2+(60-41\alpha)t)+4\alpha\xi^2(-\alpha+t+1)(-9\alpha+t(-14\alpha+18t+27)+9)+108\alpha\xi t(2t+1)(-\alpha+t+1)}{144(2t+1)(-\alpha+t+1)(-\alpha+2t+1)} + V.$

Scenario 4: $p_A^0 = \frac{t(-3(\alpha-1)(\alpha(2\eta-1)+6)+48t^2+4t(\alpha(3\eta+\xi-9)+15))}{6(-3\alpha+4t+3)(-\alpha+2t+1)}$, $p_A^1 = 3(2t+1)(-(\alpha-1)^2(2\eta-1) + 16t^2 + 4(\alpha-1)(\eta-3)t) + 4\xi(3(\alpha-1)^2 + 2(\alpha+3)t^2 - 9(\alpha-1)t)/(12(-3\alpha+4t+3)(-\alpha+2t+1))$, $p_B^0 = \frac{t(-2\alpha\xi+6t+3)}{3(-\alpha+2t+1)}$ and $x_0 = \frac{-p_A^0+p_B^0+t}{2t}$, $x_1 = \frac{\xi-p_A^1+p_B^0+t+\frac{1}{2}}{2t+1}$, $x_A^1 = -\eta + p_A^0 - p_A^1 + \frac{1}{2}$, $x_A^2 = -\xi - p_A^0 + p_A^1 + \frac{1}{2}$.

$CS_4 = (1-\alpha)(\int_{x_A^2}^{x_0}(-p_A^0 - tx + V)\,dx + \int_{x_0}^{x_1}(-p_B^0 - t(1-x) + V)\,dx) + (1-\alpha)\int_0^{x_A^1}(-p_A^0 - tx + V)\,dx + \int_{x_A^1}^{x_A^2}(-p_A^0 - tx + V)\,dx + \alpha(\int_{\frac{1}{2}}^{x_1}(-p_A^1 - tx + V + (\xi - (x - \frac{1}{2})))\,dx + \int_0^{x_A^1}(-p_A^1 - tx + V + (-\eta - x + \frac{1}{2}))\,dx + \int_{x_A^2}^{\frac{1}{2}}(-p_A^1 - tx + V + (\xi - (\frac{1}{2} - x)))\,dx) + \int_{x_1}^{1}(-p_B^0 - t(1-x) + V)\,dx$

$= 27(\alpha-1)^2\alpha(4(4\eta\xi+3(\eta-1)\eta+4\xi^2)-8\xi+3) - 5760t^4 + 288t^3(\alpha(6\eta\xi+\eta(5\eta-8)+5\xi^2+19) - 35) + 16t^2(-27\alpha\xi(\alpha(6\eta-1)-8\eta+1) + 9(\alpha(\alpha((17-14\eta)\eta-8)+\eta(19\eta-25)+42)-40) + \alpha(189 - 136\alpha)\xi^2) + 6(\alpha-1)t(\alpha(36\xi(\alpha(4\eta-2)-10\eta+3) + 3(9\alpha(1-2\eta)^2 + 4\eta(26-23\eta)-41) + 16(8\alpha - 21)\xi^2) + 180)/(288(2t+1)(-3\alpha+4t+3)(-\alpha+2t+1)) + V.$

Scenario 5: $p_A^0 = \frac{t(6\alpha\eta-4\alpha\xi+6t+3)}{-3\alpha+6t+3}$, $p_A^1 = \frac{t(6\alpha\eta-4\alpha\xi+6t+3)}{-3\alpha+6t+3} + \xi - \eta$, $p_B^0 = \frac{t(-2\alpha\xi+6t+3)}{3(-\alpha+2t+1)}$ and $x_0 = \frac{-p_A^0+p_B^0+t}{2t}$, $x_1 = \frac{2\xi-2p_A^1+2p_B^0+2t+1}{2(2t+1)}$.

$CS_5 = (1-\alpha)(\int_0^{x_0}(-p_A^0 - tx + V)\,dx + \int_{x_0}^{1}(-p_B^0 - t(1-x) + V)\,dx) + \alpha(\int_{\frac{1}{2}(1-2\eta)}^{\frac{1}{2}}(-p_A^1 - tx + V + (\xi - (\frac{1}{2} - x)))\,dx + \int_0^{\frac{1}{2}(1-2\xi)}(-p_A^1 - tx + V + (-\eta - x + \frac{1}{2}))\,dx + \int_{\frac{1}{2}(1-2\xi)}^{\frac{1}{2}(1-2\eta)}((\xi-\eta) - p_A^1 - tx + V)\,dx + \int_{\frac{1}{2}}^{x_1}(-p_A^1 - tx + V + (\xi - (x - \frac{1}{2})))\,dx + \int_{x_1}^{1}(-p_B^0 - t(1-x) + V)\,dx)$

$= \frac{-9(2t+1)((\alpha-1)\alpha(8\eta^2+1)+20t^2+t(\alpha(-8(\eta-1)\eta-4)+10))+4\alpha\xi^2(-9\alpha+4t(-4\alpha+9t+9)+9)+36(\alpha-1)\alpha\xi(2t+1)}{72(2t+1)(-\alpha+2t+1)} + V.$

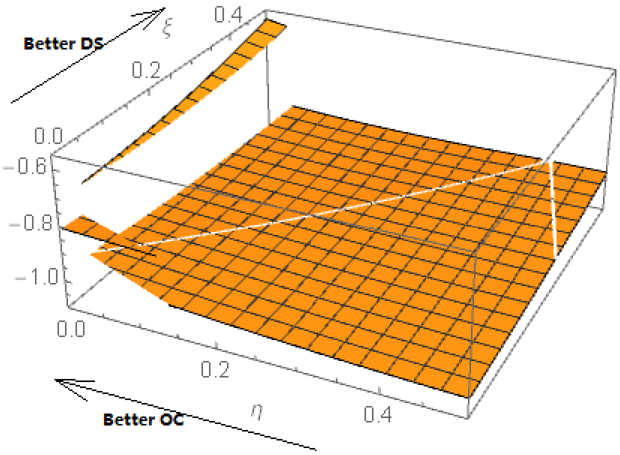
Figure A1 illustrates the consumer surplus as a function of ξ and η (when $\alpha = 1/2$ and $t = 2/3$).

□

A.2.10 Proof of Proposition 6

Proof. The calculation procedure is similar to what we did in the proof of previous propositions, except that whenever Brand A is involved there is an ϵ accompanied. Thus, we skip the calculation

Figure A1: Consumer Surplus and Parameter Space (η, ξ) when $\alpha = 1/2, t = 2/3$



details and only provide the results here:

For benchmark case, $p^0_{A\text{bench}} = t + \frac{\epsilon}{3}, p^0_{B\text{bench}} = t - \frac{\epsilon}{3}$, and $\pi_{A\text{bench}} = \frac{(3t+\epsilon)^2}{18t}$, $\pi_{B\text{bench}} = \frac{(3t-\epsilon)^2}{18t}$.

For OC case, if both adopt the new channel, the prices are $p^0_A = \frac{1}{3}(\epsilon + 3t), p^0_B = \frac{1}{3}(3t - \epsilon), p^1_A = \frac{1}{12}(4\epsilon - 6\eta + 12t + 3), p^1_B = \frac{1}{12}(-4\epsilon - 6\eta + 12t + 3)$, and the profits are $\pi_A = \frac{1}{144}\left(9\alpha(1-2\eta)^2 + \frac{8(\epsilon+3t)^2}{t}\right)$, $\pi_B = \frac{1}{144}\left(9\alpha(1-2\eta)^2 + \frac{8(-\epsilon+3t)^2}{t}\right)$.

For OC case, if only A adopts, the prices are $p^0_A = \frac{1}{3}(\epsilon + 3t), p^0_B = \frac{1}{3}(3t - \epsilon), p^1_A = \frac{1}{12}(4\epsilon - 6\eta + 12t + 3)$, and the profits are $\pi_A = \frac{1}{144}\left(9\alpha(1-2\eta)^2 + \frac{8(\epsilon+3t)^2}{t}\right), \pi_B = \frac{(3t-\epsilon)^2}{18t}$.

For OC case, if only B adopts, the prices are $p^0_A = \frac{1}{3}(\epsilon + 3t), p^0_B = \frac{1}{3}(3t - \epsilon), p^1_B = \frac{1}{12}(-4\epsilon - 6\eta + 12t + 3)$, and the profits are $\pi_A = \frac{(3t+\epsilon)^2}{18t}, \pi_B = \frac{1}{144}\left(9\alpha(1-2\eta)^2 + \frac{8(-\epsilon+3t)^2}{t}\right)$.

In the OC case, it is again pretty clear that it is only a within-brand switch of the customers, so both of them have the incentive to adopt the new channel no matter what the other one does. Therefore, in the equilibrium, both brands adopt the new channel and the stronger brand ends up with a higher profit than the weaker one.

For DS case, if both adopt the new channel, the prices are $p^0_{A\text{both}} = -\frac{\alpha\epsilon - 4\epsilon t - \epsilon - 12t^2 + 6\alpha\xi t - 3t}{3(-\alpha+4t+1)}$, $p^0_{B\text{both}} = -\frac{-\alpha\epsilon + 4\epsilon t + \epsilon - 12t^2 + 6\alpha\xi t - 3t}{3(-\alpha+4t+1)}$, $p^1_{A\text{both}} = -\frac{\alpha\epsilon - 4\epsilon t - \epsilon - 12t^2 + 6\alpha\xi t - 6\xi t}{3(-\alpha+4t+1)}$, $p^1_{B\text{both}} = -\frac{-\alpha\epsilon + 4\epsilon t + \epsilon - 12t^2 + 6\alpha\xi t - 6\xi t}{3(-\alpha+4t+1)}$, and the profits are $\pi_{A\text{both}} = \frac{1}{18}\left(\frac{\epsilon^2}{t} + 6\epsilon + \frac{9t\left(-(\alpha-1)(4\alpha(\xi-1)\xi+1)+16t^2+t(\alpha(8(\xi-1)\xi-6)+8)\right)}{(\alpha-4t-1)^2}\right)$,

$\pi_{B\text{both}} = \frac{1}{18}\left(\frac{-\epsilon^2}{t} + 6\epsilon + \frac{9t\left(-(\alpha-1)(4\alpha(\xi-1)\xi+1)+16t^2+t(\alpha(8(\xi-1)\xi-6)+8)\right)}{(\alpha-4t-1)^2}\right)$.

For DS case, if only A adopt the new channel, the prices are

$p^0_{A\text{onlyA}} = \frac{1}{6}\left(2\epsilon + \frac{3t(-2\alpha+t(-3\alpha+4t+6)+2)-2\alpha\xi t(-\alpha+t+1)}{(-\alpha+t+1)(-\alpha+2t+1)}\right)$, $p^0_{B\text{onlyA}} = \frac{\epsilon(\alpha-2t-1)+t(-2\alpha\xi+6t+3)}{-3\alpha+6t+3}$, $p^1_{A\text{onlyA}} = \frac{1}{12}\left(4\epsilon + \frac{3t(2t+1)(-3\alpha+4t+3)-2\xi(3(\alpha-1)+2(\alpha-3)t)(-\alpha+t+1)}{(-\alpha+t+1)(-\alpha+2t+1)}\right)$, and the profits are

$\pi_{B\text{onlyA}} = \frac{(\epsilon(-\alpha+2t+1)+t(2\alpha\xi-6t-3))^2}{18t(2t+1)(-\alpha+2t+1)}$, $\pi_{A\text{onlyA}} = \pi_B + \frac{2\epsilon}{3} + \frac{\alpha(2\xi(-\alpha+t+1)+3t)(6\xi(-\alpha+t+1)+t)}{24(-\alpha+t+1)(-\alpha+2t+1)}$.

For DS case, if only B adopt the new channel, the prices are

$p^0_{B\text{onlyB}} = \frac{1}{6}\left(-2\epsilon + \frac{3t(-2\alpha+t(-3\alpha+4t+6)+2)-2\alpha\xi t(-\alpha+t+1)}{(-\alpha+t+1)(-\alpha+2t+1)}\right)$, $p^0_{A\text{onlyB}} = \frac{-\epsilon(\alpha-2t-1)+t(-2\alpha\xi+6t+3)}{-3\alpha+6t+3}$, $p^1_{B\text{onlyB}} = \frac{1}{12}\left(-4\epsilon + \frac{3t(2t+1)(-3\alpha+4t+3)-2\xi(3(\alpha-1)+2(\alpha-3)t)(-\alpha+t+1)}{(-\alpha+t+1)(-\alpha+2t+1)}\right)$, and the profits are $\pi_{A\text{onlyB}} = \frac{(-\epsilon(-\alpha+2t+1)+t(2\alpha\xi-6t-3))^2}{18t(2t+1)(-\alpha+2t+1)}$, $\pi_{B\text{onlyB}} = \pi_A + \frac{-2\epsilon}{3} + \frac{\alpha(2\xi(-\alpha+t+1)+3t)(6\xi(-\alpha+t+1)+t)}{24(-\alpha+t+1)(-\alpha+2t+1)}$.

In order to make the equilibrium well-defined, we also have to check that all the prices and demands are positive and give some restriction on ϵ so that our results can remain reasonable. Under our parameter space $0 < \alpha < 1$, $0 < \xi < 1/2$, $t > 1/2$, this restriction is calculated to be $0 \le \epsilon < \bar{\epsilon}(\alpha, t, \xi)$, where $\bar{\epsilon}(\alpha, t, \xi) := \min\{\frac{t(2\xi(-\alpha+t+1)(-2\alpha+6t+3)+3t(2t+1))}{2(-\alpha+t+1)(-\alpha+2t+1)}, \frac{6t(-\alpha\xi+\xi+2\xi t+t)}{-\alpha+4t+1}\}$.

Under the restricted parameter space, one can easily check $\pi_{A\text{onlyA}} > \pi_{A\text{bench}}$ and $\pi_{B\text{onlyB}} > \pi_{B\text{bench}}$ through some algebra, so both not adopting (NN) is not an equilibrium – either one has the incentive to deviate for a higher profit. With some algebra, it's also easy to check $\pi_{B\text{onlyA}} > \pi_{B\text{both}}$, which means that both adopting (YY) is also not an equilibrium since B always has the incentive to deviate to not adopting given that A adopts.

Now let's check (YN) and (NY):

(YN) is definitely an equilibrium since $\pi_{A\text{onlyA}} > \pi_{A\text{bench}}$ and $\pi_{B\text{onlyA}} > \pi_{B\text{both}}$, i.e. neither A nor B has the incentive to deviate. This is the same as the symmetric setting.

(NY) may or may not be an equilibrium. Since $\pi_{B\text{onlyB}} > \pi_{B\text{bench}}$, B will not have the incentive to deviate. However, we are not sure whether A has the incentive to deviate because we have not determine the relative size between $\pi_{A\text{onlyB}}$ and $\pi_{A\text{both}}$. In other words, (NY) is an equilibrium if and only if $\pi_{A\text{onlyB}} > \pi_{A\text{both}}$. With some algebra, one can know that A has the incentive to deviate iff $\pi_{A\text{onlyB}} < \pi_{A\text{both}}$ iff $\underline{\xi}(\alpha, t) < \xi < \frac{1}{2}$ and $\underline{\epsilon}(\alpha, t, \xi) < \epsilon < \bar{\epsilon}(\alpha, t, \xi)$, where $\underline{\xi}(\alpha, t) := \max\{\sqrt{\frac{144((2t+1)(-\alpha+2t+1)^3(\alpha-4t-1)^2((\alpha-1)^2+24t^3-6(4\alpha-5)t^2+2(3\alpha^2-8\alpha+5)t))}{(-\alpha+t+1)((\alpha-1)^2(16\alpha^2-72\alpha+57)+1920t^4-96(28\alpha-33)t^3+4(337\alpha^2-822\alpha+489)t^2-4(68\alpha^3-269\alpha^2+336\alpha-135)t)^2}} - \frac{3(2t+1)\left(-8(\alpha-1)^4+192t^4+(176-160\alpha)t^3+\left(-6\alpha^2+4\alpha+2\right)t^2+(\alpha-1)^2(36\alpha-35)t\right)}{2(-\alpha+t+1)((\alpha-1)^2(16\alpha^2-72\alpha+57)+1920t^4-96(28\alpha-33)t^3+4(337\alpha^2-822\alpha+489)t^2-4(68\alpha^3-269\alpha^2+336\alpha-135)t)}, \frac{3}{4}\left(\frac{(\alpha-1)^2-24t^3+2(7\alpha-8)t^2-2(\alpha-1)\alpha t}{-2(\alpha-1)^2(2\alpha-3)+60t^3+(84-79\alpha)t^2+(32\alpha^2-71\alpha+39)t} + \sqrt{\frac{(2t+1)(\alpha-4t-1)^2((\alpha-1)^2+48t^3+(48-44\alpha)t^2+2(5\alpha^2-12\alpha+7)t)}{(-2(\alpha-1)^2(2\alpha-3)+60t^3+(84-79\alpha)t^2+(32\alpha^2-71\alpha+39)t)^2}}\right)\}$ and $\underline{\epsilon}(\alpha, t, \xi) := 2\left(\sqrt{-\frac{t^2(2t+1)(2(\alpha-1)^2\xi(4\xi-3)+(20\xi^2+12\xi-27)t^2-(\alpha-1)(28\xi^2-12\xi-9)t)}{(-\alpha+2t+1)(\alpha-4t-1)^2}} - \xi t\right)$.

Thus, we have: for any given α and t, there exists $\underline{\xi} \in (0, \frac{1}{2})$ and $\underline{\epsilon} \in (0, \infty)$, such that for all $\xi \in (\underline{\xi}, \frac{1}{2})$ and $\epsilon \in (\underline{\epsilon}, \bar{\epsilon})$ (NY) is not an equilibrium. This concludes the proof.

□

A.3 Omitted Long Expressions

A.3.1 Prices and Profits under Different Adoption Decisions when AI-Device Offers OC

See Table A3.

Table A3: OC Case: Prices and Profits under Different Adoption Decisions

	One Brand (A) Adopts AI channel		Both Brands channel Adopt AI channel		Neither Brand Adopts AI channel
p_A^0	t	$=$	t	$=$	t
p_B^0	t	$=$	t	$=$	t
p_A^1	$t+\frac{1-2\eta}{4}$	$=$	$t+\frac{1-2\eta}{4}$	$>$	(t)
p_B^1	NA		$t+\frac{1-2\eta}{4}$	$>$	(t)
π_A	$\frac{t}{2}+\frac{\alpha}{4}(\frac{1}{2}-\eta)^2$	$=$	$\frac{t}{2}+\frac{\alpha}{4}(\frac{1}{2}-\eta)^2$	$>$	$\frac{t}{2}$
π_B	$\frac{t}{2}$	$<$	$\frac{t}{2}+\frac{\alpha}{4}(\frac{1}{2}-\eta)^2$	$>$	$\frac{t}{2}$

A.3.2 Expression for $\Delta^{OC+DS}(x)$

Since $\Delta^{OC}(x) = |x-\frac{1}{2}|-\eta$, $\Delta^{DS}(x) = \xi-|x-\frac{1}{2}|$, and $\Delta^{OC+DS}(x) = \max\{\Delta^{OC}(x), \Delta^{DS}(x), \Delta^{OC}(x)+\Delta^{DS}(x)\}$, with some basic algebra it is easy to know that

if $\xi \leq \eta$,

$$\Delta^{OC+DS}(x) = \begin{cases} \frac{1}{2}-x-\eta & \text{if } 0 \leq x \leq \frac{1-(\xi+\eta)}{2} \\ \xi-(\frac{1}{2}-x) & \text{if } \frac{1-(\xi+\eta)}{2} < x \leq \frac{1}{2} \\ \xi-(x-\frac{1}{2}) & \text{if } \frac{1}{2} < x \leq \frac{1+(\xi+\eta)}{2} \\ x-\frac{1}{2}-\eta & \text{if } \frac{1+(\xi+\eta)}{2} < x \leq 1; \end{cases} \tag{A1}$$

if $\xi > \eta$,

$$\Delta^{OC+DS}(x) = \begin{cases} \frac{1}{2}-x-\eta & \text{if } 0 \leq x \leq \frac{1-2\xi}{2} \\ \xi-\eta & \text{if } \frac{1-2\xi}{2} < x \leq \frac{1-2\eta}{2} \\ \xi-(\frac{1}{2}-x) & \text{if } \frac{1-2\eta}{2} < x \leq \frac{1}{2} \\ \xi-(x-\frac{1}{2}) & \text{if } \frac{1}{2} < x \leq \frac{1+2\eta}{2} \\ \xi-\eta & \text{if } \frac{1+2\eta}{2} < x \leq \frac{1+2\xi}{2} \\ x-\frac{1}{2}-\eta & \text{if } \frac{1+2\xi}{2} < x \leq 1. \end{cases} \tag{A2}$$

A.3.3 Full Expression for Proposition 3

When devices offer both DS and OC functionality, there are five scenarios in the $\xi-\eta$ space to define equilibria outcomes:

- **(Scenario 1: Uniformity – AI Serves All)**
  If $0 < \eta < \frac{\alpha}{6(1+2t)}$ and $\max\{\frac{3\eta(1+2t)}{\alpha}, \frac{(1-\alpha)(10\eta+1)+12\eta t}{8(1-\alpha)+12t}\} < \xi < \frac{1}{2}$, both brands adopt the AI-enabled channel in the equilibrium with prices $p_A^0 = p_B^0 = p_A^1 = p_B^1 = t$ and profits $\pi_A = \pi_B = \frac{t}{2}$.

- **(Scenario 2: Uniformity – AI Serves Brand Loyal)**
  If $0 < \eta < \frac{1-\alpha}{4t+2(1-\alpha)}$ and $0 < \xi < \frac{(1-\alpha)(1-2\eta)-4\eta t}{8(1-\alpha)+12t}$, both brands adopt the AI-enabled channel in the equilibrium with prices $p_A^0 = p_B^0 = t$ and $p_A^1 = p_B^1 = t + \frac{1-2\eta}{4}$ and profits $\pi_A = \pi_B = \frac{t}{2} + \frac{\alpha}{4}(\frac{1}{2} - \eta)^2$.

- **(Scenario 3: Specialization – AI Serves Less Brand Loyal)**
  If $\frac{3(1-\alpha+2t)}{10(1-\alpha)+12t} < \eta < \frac{1}{2}$ and $\frac{5(1-\alpha)(1-2\eta)+t(8-12\eta)}{4(1-\alpha+t)} < \xi < \frac{1}{2}$, only one brand (WLOG, say A) adopts the AI-enabled channel in the equilibrium with prices $p_A^0 = t\Big(1+\frac{\alpha\big(t(9-2\xi)+2(1-\alpha)(3-\xi)\big)}{6(1-\alpha+t)(1-\alpha+2t)}\Big)$, $p_A^1 = p_A^0 + \frac{\xi}{2} - \frac{t}{4(1-\alpha+t)}$, $p_B^0 = \frac{t(6t-2\alpha\xi+3)}{3(1-\alpha+2t)}$ and profits $\pi_B = \frac{t(3-2\alpha\xi+6t)^2}{18(1+2t)(1-\alpha+2t)}$,
  $\pi_A = \pi_B + \frac{\alpha(2\xi(1-\alpha+t)+3t)(6\xi(1-\alpha+t)+t)}{24(1-\alpha+t)(1-\alpha+2t)}$.

- **(Scenario 4: Specialization – AI Serves the most Brand Loyal and Less Loyal)**
  If ξ and η do not satisfy the premises in Scenarios 1-3 and $0 < \xi < \frac{(1-\alpha)(10\eta+1)+12\eta t}{8(1-\alpha)+12t}$, only one brand (WLOG, say A) adopts the AI-enabled channel in the equilibrium with prices $p_A^0 = t\Big(1+\frac{\alpha(4t(3\eta+\xi+6)+3(1-\alpha)(2\eta+5))}{6(3-3\alpha+4t)(1-\alpha+2t)}\Big)$, $p_A^1 = p_A^0 + \frac{\alpha(2\eta-4\xi-1)-2\eta(2t+1)+4\xi(t+1)+1}{4(3-3\alpha+4t)}$, $p_B^0 = \frac{t(6t-2\alpha\xi+3)}{3(1-\alpha+2t)}$ and profits $\pi_B = \frac{t(3-2\alpha\xi+6t)^2}{18(1+2t)(1-\alpha+2t)}$, $\pi_A = \pi_B + \frac{\alpha\big(8\xi\big(3(1-\alpha)^2(1-2\eta)+4(8-3\eta)t^2+9(1-\alpha)(3-2\eta)t\big)+3((1-\alpha)(1-2\eta)-4t\eta)^2+48\xi^2(1-\alpha+t)^2\big)}{48(3-3\alpha+4t)(1-\alpha+2t)}$

- **(Scenario 5– Specialization – AI Serves All Customers of One Brand)**
  Otherwise, only one brand (WLOG, say A) adopts the AI-enabled channel in the equilibrium with prices $p_A^0 = \frac{t(2\alpha(3\eta-2\xi)+3(1+2t))}{3(1-\alpha+2t)}$, $p_A^1 = p_A^0 + \xi - \eta$, $p_B^0 = \frac{t(6t-2\alpha\xi+3)}{3(1-\alpha+2t)}$ and profits $\pi_B = \frac{t(3-2\alpha\xi+6t)^2}{18(1+2t)(1-\alpha+2t)}$, $\pi_A = \pi_B + \frac{3\alpha(1-\alpha)(1+2\eta)(\xi-\eta)+8\alpha\xi t}{6(1-\alpha+2t)}$.

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Supplemental Appendix – ONLINE ONLY

Experimental Materials

SA.1 Study 1

[DESCRIPTIVE TEXTS AND FIGURE FOR "OC" GROUP]

"Shopbot" is a smart shopping device using artificial intelligence (AI). This device can be used to shop with voice commands.

When you need to buy, for example, a toothpaste, you can say to Shopbot: "Shopbot, buy me XXX (brand name) toothpaste", and Shopbot will order it for you. The next time you want toothpaste, you can just say: "Shopbot, buy me toothpaste", and Shopbot will order the same toothpaste you bought the last time.

[DESCRIPTIVE TEXTS AND FIGURE FOR "DS" GROUP]

"Shopbot" is a smart shopping-support device using artificial intelligence (AI). This device can help you make purchase decisions when you need it.

When you need, for example, a toothpaste, you can turn to Shopbot and ask which brand to buy. Based on its understanding of your past purchase behavior and online product information, Shopbot can suggest you a toothpaste brand. If you want, it can also give you tips on how to choose among different brands.

["HIGH PRODUCT KNOWLEDGE" GROUP SEE THE FOLLOWING QUESTION]

Think of a product category (e.g. shampoo, motor oil, etc.) you know a lot about. Please write down the product category: [ ]

["LOW PRODUCT KNOWLEDGE" GROUP SEE THE FOLLOWING QUESTION]

Think of a product category (e.g. shampoo, motor oil, etc.) you **do NOT** know a lot about. Please write down the product category: [ ]

[QUESTIONS FOR EVERYONE]

Do you have a preferred brand in this product category?

- Definitely yes
- Probably yes
- Might or might not
- Probably not
- Definitely not

What's your favorite brand in this product category? (If no favorite brand, just write "NA") [ ]

When you need to buy this product, how likely will you use Shopbot?

- Highly likely
- Likely
- Not sure
- Unlikely
- Highly unlikely

Why or why not do you want to use Shopbot when purchasing this product? [ ]

[MANIPULATION CHECK QUESTIONS]

Do you think Shopbot makes it easier to choose between brands?

- Definitely yes
- Probably yes
- Might or might not
- Probably not
- Definitely not

Do you think Shopbot makes it easier to order products?

- Definitely yes
- Probably yes
- Might or might not
- Probably not
- Definitely not

SA.2 Study 2

[DESCRIPTIVE TEXTS AND FIGURE FOR "OC" GROUP]

"Shopbot" is a smart shopping device using artificial intelligence (AI). This device can be used to shop with voice commands.

When you need to buy, for example, a detergent, you can simply say to Shopbot: "Shopbot, buy me XXX (brand name) detergent", and Shopbot will order it for you. The next time you want detergent, you can just say: "Shopbot, buy me detergent", and Shopbot will order the same detergent you bought the last time. You can review the prices if you want. The shipping cost is marginal.

[DESCRIPTIVE TEXTS AND FIGURE FOR "DS" GROUP]

"Shopbot" is a smart shopping-support device using artificial intelligence (AI). This device can help you make purchase decisions when you need it.

When you need, for example, a detergent, you can turn to Shopbot and ask which brand to buy. Based on its understanding of your past purchase behavior and online product information, Shopbot can suggest you a detergent brand. If you want, it can also give you shopping tips on how to choose among different brands.

[QUESTIONS FOR EVERYONE]

Which headphone brand do you prefer?

- Sony
- Bose
- I am indifferent between the two brands above

Is your preference over the brand you chose in the previous question strong?

- Yes, my brand preference is strong
- No, my brand preference is weak

Which cereals brand do you prefer?

- Cheerios
- Frosted Flakes
- I am indifferent between the two brands above

Is your preference over the brand you chose in the previous question strong?

- Yes, my brand preference is strong
- No, my brand preference is weak

Which of the functions below does Shopbot have? [Select all that apply]

- With Shopbot, you can shop using your voice
- Shopbot can help you find used items being sold nearby
- Shopbot can provide you with shopping tips when you need

When you need to buy a headphone (Sony or Bose), how likely will you use Shopbot?

- Highly likely
- Likely
- Not sure
- Unlikely

- Highly unlikely

How much do you think you know about headphones?

- Very much
- Much
- Not sure
- Little
- Very little

When you need to buy cereals (Cheerios or Frosted Flakes), how likely will you use Shopbot?

- Highly likely
- Likely
- Not sure
- Unlikely
- Highly unlikely

How much do you think you know about cereals?

- Very much
- Much
- Not sure
- Little
- Very little

SA.3 Supplemental Study

["HIGH PRODUCT KNOWLEDGE" GROUP SEE THE FOLLOWING QUESTION]

Think of a product category (e.g. cereals, headphone, etc.) you know a lot about. Please write down the product category: [ ]

["LOW PRODUCT KNOWLEDGE" GROUP SEE THE FOLLOWING QUESTION]

Think of a product category (e.g. cereals, headphone, etc.) you **do NOT** know a lot about. Please write down the product category: [ ]

[QUESTIONS FOR EVERYONE]

Do you have a preferred brand in this product category?

- Definitely yes
- Probably yes
- Might or might not
- Probably not
- Definitely not

Suppose now you can use a smart shopping device, which is enabled by artificial intelligence (AI), to purchase the product you just wrote. There are two possible functionalities that the device can provide:

(1) [Decision Support] Help you decide which brand to buy (providing product recommendations, lists, or additional product information)

(2) [Ordering Convenience] Make your ordering more convenient (ordering through voice command, shopping via camera, or auto-refilling functions)

Which functionality do you prefer the shopping device to have?

- Strongly prefer Decision Support
- Prefer Decision Support
- Indifferent between Decision Support and Ordering Convenience
- Prefer Ordering Convenience
- Strongly prefer Ordering Convenience